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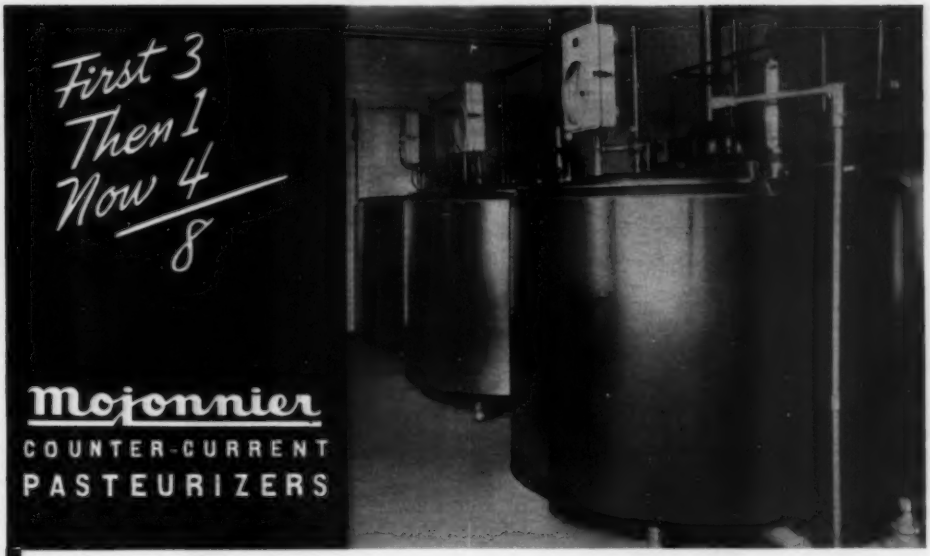

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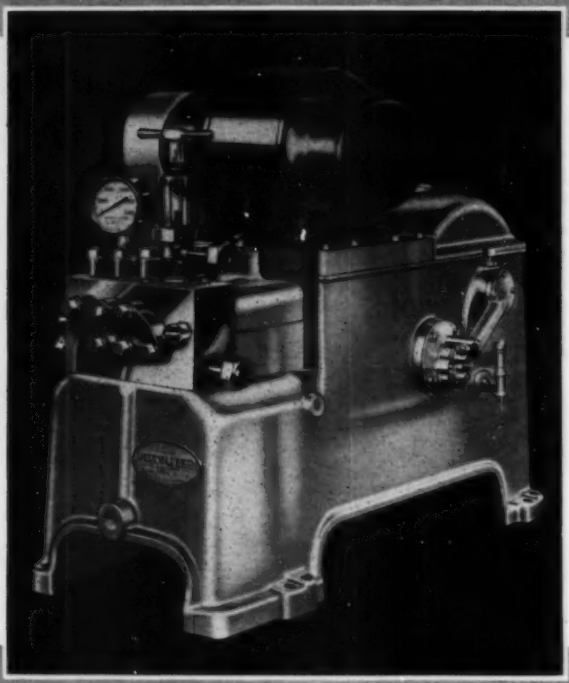

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JOURNAL OF DAIRY SCIENCE

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THE COMPOSITION OF LIMONITES EFFECTIVE AND INEFFECTIVE IN CORRECTING "BUSH SICKNESS" IN CATTLE

R. B. BECKER AND L. W. GADDUM
Florida Agricultural Experiment Station, Gainesville, Florida

Bush sickness of sheep and cattle on certain soil areas in New Zealand resembles "salt sick" (nutritional anemia) on definite areas in Florida, hence there is mutual interest in problems relating to these conditions. It was desired to compare the composition of supplements used to correct these conditions. realizing however that differences in soils over which livestock graze also affect the amounts of mineral elements in the feed supply. An exchange of iron supplements used in the correction and prevention of bush sickness was effected between the New Zealand Department of Agriculture and the Florida Agricultural Experiment Station through the courtesy of Dr. B. C. Aston, Chief Chemist, New Zealand Department of Agriculture. Two samples of native iron-bearing ore, "limonite," tested as correctives for bush sickness, were received. Although these samples of limonite were in many respects the same, one of them from Whangarei (Ruatangata) was effective against the anemia, whereas the other from Puhipuhi was ineffective.

The New Zealand limonite samples were subjected to spectrographic analysis in the Spectrographic Laboratory of the Florida station. The results of these analyses are not "precision" data, but rather are estimates based on ratio quantitative comparisons with standards. There was quite close agreement in the main between the analyses by chemical methods as reported by Grimmett and Shorland (2) and these spectrographic analyses (see Table 1) even though the samples may have originated at different points in these mineral deposits. Additional elements likely to prove beneficial, or have unfavorable effects, were sought in the spectrographic analysis, including bismuth, cadmium, lead, lithium, molybdenum, silver, strontium, thallium, tin, tungsten, yttrium, vanadium and zinc.

Of the elements mentioned, bismuth, cadmium, lead, lithium, silver, thallium, tungsten, yttrium and zinc were not detected in either ore.

The effective and ineffective ores both contained .001 per cent of the elements chromium, molybdenum and vanadium. Both samples were shipped in tin containers, which are suspected of being the source of the

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TABLE 1

Comparison of spectrographic and chemical methods of analysis of effective and ineffective limonite ores used in treatment of bush sickness in New Zealand cattle and sheep

	SPECTROGRAPHIC ANALYSES*		CHEMICAL ANALYSES (2)	
	Effective ore	Ineffective ore	Effective ore	Ineffective ore**
	Per cent	*Per cent*	*Per cent*	*Per cent*
Alumina (Al_2O_3)	2.00	2.00	5.24	2.54
Antimony trioxide (Sb_2O_3)	not found	.1	not found	.04
Arsenic trioxide (As_2O_3)	not found	present	trace	.033
Barium oxide (BaO)	.001	.1	not given	.27
Calcium oxide (CaO)	present	present	.58	.65
Chromium sesquioxide (Cr_2O_3)	.0015	.0015	not found	not found
Cobaltous oxide (CoO)	.005	not found	trace	trace
Cupric oxide (CuO)	.015	.015	.08	not found
Manganese dioxide (MnO_2)	.80	.80	.79	2.45
Molybdenum trioxide (MoO_3)	.0015	.0015	.....	.....
Nickelous oxide (NiO)	.0005	.0015	.01	trace
Strontium oxide (SrO)	not found	.006	.....	.....
Stannic oxide (SnO_2)	.006	.006	.....	.....
Titanium dioxide (TiO_2)	.15	.30	.31	.40
Vanadium pentoxide (V_2O_5)	.002	.002	.....	.....
Alkalis (K_2O, Na_2O)	.....	.....	trace	.02
Carbon dioxide (CO_2)	.....	.....	.....	.49
Ferric oxide (Fe_2O_3)	.....	.....	62.30	71.25
Phosphorus pentoxide (P_2O_5)	.....	.....	.82	.40
Silica (SiO_2)	.....	.....	7.79	6.33
Sulfur (S)	.....	.....	not found	.16
Magnesia (MgO)	.....	.....	.05	.08
Loss on ignition	.....	.....	13.01	12.12
Moisture	.....	.....	9.59	3.20

* Determined as elements; calculated to oxide equivalent for comparison.
** Fusion analysis by Mr. Seelye, courtesy of the New Zealand Dominion Analyst.

.005 per cent of tin found in each sample. The ineffective sample contained 100 times as much barium (.1 to .001 per cent Ba), as did the effective sample. Barium may be a factor to consider with regard to the ineffectiveness of the Puhipuhi limonite. The ineffective ore also contained .005 per cent strontium not found in the effective ore. These percentages of the elements as determined spectrographically, have been computed to their oxide equivalents for comparison with the chemical analyses of similar samples of ore from the same deposits, as shown in Table 1.

Approximately equal amounts of copper were found consistently in both samples, even upon 12 replicate determinations. The spectrographic method of analysis does not entail contaminations with reagents, and hence is more reliable than usual chemical estimations when dealing with *small amounts* of copper.

Cobalt was not found in the ineffective limonite by spectrographic examination. Even with 10 to 15 times longer exposure of the photographic plates, no cobalt line was found on the negative. The effective limonite, however, contained .005 per cent of the element. In view of the recent work of Underwood and Filmer (1, 4), and unpublished results by Neal (3) at the Florida station, it appears that cobalt is an essential element in animal nutrition.

Cobalt then appears worthy of further investigation in conjunction with ineffective ores. Its absence may explain the ineffectiveness of the Ruatangata ore, and also that of another ineffective ore (Onekaka) in which Grimmett and Shorland (2) did not find the element.

Beryllium, a metal with potential commercial value, was encountered in the systematic search of the spectrograms of the Puhipuhi limonite. Although only a small percentage was found (.005 per cent Gl), its presence may indicate the existence of larger deposits in the vicinity of the discovery.

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ADDENDA

Since the above communication was written and submitted as information to the New Zealand Department of Agriculture in June, 1936, much progress has been made in the study of the use of cobalt in malnutrition of cattle and sheep in West and South Australia, New Zealand and Florida. It is interesting to note that K. J. McNaught (New Zeal. Jour. Sci. and Technol. 18: 655–661. 1937) has substantiated variations ranging between 5.2 and 281.0 parts per million of cobalt in various samples of limonite taken from Okaihau quarries in New Zealand. His analyses were by chemical methods.

The accompanying paper—"The essentiality of cobalt in bovine nutrition,"* by Drs. W. M. Neal and C. F. Ahmann in this issue of the JOURNAL OF DAIRY SCIENCE, reviews the literature available at time of submitting the manuscript.

Our thanks are expressed to Dr. B. C. Aston, formerly Chief Chemist of the New Zealand Department of Agriculture, who arranged the exchange of mineral supplements for mutual study. Dr. Aston retired on August 31, 1936, after over forty years of illustrious service in the field of chemistry and nutrition.

THE ESSENTIALITY OF COBALT IN BOVINE NUTRITION

W. M. NEAL AND C. F. AHMANN
Florida Agricultural Experiment Station, Gainesville, Florida.

The investigation of salt sick (nutritional anemia) in cattle has followed the lines of response of animals in the field to mineral supplement (5, 19), the composition of forage from healthy and affected areas (20, 25), the composition of the soils from the same areas (6), a survey to determine the extent of the condition, and controlled feeding trials with cattle.

The feeds used in these trials with the exception of commercial spray-process skimmilk powder, have been produced on affected areas. The use of iron and copper supplement which was successful in most field tests on less restricted rations has given negative response, while the use of cobalt supplement has allowed normal growth. Details of these trials are to be reported.

LITERATURE

The initial use of cobalt to correct a specific nutritional disorder must be credited to Marston (14) and Lines (13), and Filmer and Underwood (7, 8, 27, 28) in Australia. "Coast disease" in sheep in South Australia was cured by the use of limonite, or by the use of Jansen's salt mixture which, among other elements, contained manganese, zinc, cobalt and nickel. Lines (13), in 1935, reported the recovery of two sheep given 1.0 mg. of cobalt per head per day as nitrate, and that they showed improvement within three days.

Filmer (7), in 1933, in writing of enzootic marasmus of sheep and cattle in West Australia stated ". . . enzootic marsmus is due to a deficiency of some mineral necessary for the metabolism of iron . . ." and ". . . the hypothetical mineral is commonly found in association with iron, and that the effective doses of iron compounds depend on the proportion in which the mineral is present in available form." In 1934, Filmer and Underwood (8) reported that 50 grams of limonite daily would cure cattle, that a 0.125 N hydrochloric acid extract of the same amount of limonite (iron-free) would cure also, but that the extracted residue would not.

Underwood (27) found three to eight times as much iron in the livers, kidneys and spleens of affected sheep and cattle as was found in healthy animals, indicating that there was no deficiency of iron. The biologically potent element of limonte was announced in 1935 by Underwood and Filmer (28) as the result of experiments testing the fractions of the iron-free filtrate, and the individual elements of the effective fractions. The final test was the administration of 2.0, 1.0 and 0.1 mgs. of cobalt, respectively, to affected sheep with resultant recovery of condition and gain in weight.

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In 1935, Grimmett and Shorland (10) held that iron *per se* was necessary for the prevention of bush sickness in New Zealand but that cobalt and other elements might have a stimulating effect. However, in 1936, Askew and Dixon (1) reported that 4.0 mgs. cobalt per sheep twice weekly was sufficient to prevent the condition. Like amounts of nickel were ineffective. These trials were conducted at Glenhope, Nelson and Morton Mains, Southland on the South Island, New Zealand. The efficacy of soil extracts and other drenches was found to be dependent on their cobalt content, and as little as 0.4 mg. of cobalt per week was effective with sheep.

Cobalt, as well as Reyburn's limonite, was found to be effective at Kahoroa (North Island) by Wall (29), in the treatment of bush sickness when given at the rate of 1.0 mg. per head per day. The opinion was held that elements other than cobalt might be necessary for the absolute control of the condition.

After cobalt was shown to be effective, the New Zealand study was expanded to include the cobalt content of limonites and other drench materials, the effect of top-dressing on pasture plants, and the cobalt content of soils and animal organs. McNaught (16) found 17–96 p.p.m. of cobalt in Ruatangata (Reyburn's) limonite; 5.2–281 p.p.m. in Okaihua limonite depending on the strata; and 7.0 p.p.m. in ferric ammonium citrate which was effective. Ineffective ores were lowest. Bush sick soils contained 0.12, Morton Mains ailment soils 0.39, and healthy soils 0.61 p.p.m. of cobalt extractable with 0.1 N hydrochloric acid.

The method used was that of Kidson, Askew and Dixon (12), which is an adaptation of that of Stare and Elvehjem (26) and depends on the formation of a red complex by cobalt and nitroso-R-salt (Van Klooster's reagent). This same method was used in the following.

A more extended soil study by Kidson (11) showed a variation from 0.3 to 380 p.p.m. of cobalt extractable with concentrated hydrochloric acid. Few soils contained more than 20 p.p.m. unless of basic origin. Most bush sick soils contained less than 2.0 p.p.m. Morton Mains soils contained from 2.8 to 8.3 p.p.m. with no correlation between sick and healthy, and some healthy soils contained less than 2.0 p.p.m. Cobalt content was not considered to be a sufficient guide to determine the use of cobalt supplement.

Askew and Dixon (2) top-dressed pastures with cobaltous chloride ($CoCl_2 \cdot 6H_2O$). They found increases to 6.7 and 74 p.p.m. from 0.20 and 0.24 p.p.m. using 10 and 100 pound applications per acre, respectively, on affected soil. Legumes took up more cobalt than grasses but were less tolerant, phosphate favored uptake, and lime depressed it. Higher applications eliminated weeds and many of the legumes, thus depressing total yield. Cobalt apparently was fixed in the soil complex to some extent.

Askew (3) found the average cobalt content of liver, blood, spleen, kidney and pancreas of the control and cobalt-treated sheep referred to earlier (1) to be 0.05 and 0.11 p.p.m. respectively, on the dry basis. The pancreas was

highest in the control animals and the liver and kidneys in the treated. Dixon (3) found the comparison between controls and treated (average of three animals each) on the dry basis to be as follows: liver, 0.025 and 0.20 p.p.m.; blood, 0.01 and 0.03 p.p.m.; spleen, 0.03 and 0.04 p.p.m.; and pancreas, 0.025 and 0.07 p.p.m. They estimated that there is less than 30 mgs. cobalt in a 100-pound lamb, and that the element is poorly assimilated.

Unpublished results (25) of spectrographic analyses of wire grass (*Aristida* sp.) collected from healthy and salt sick areas in Florida showed no detection of cobalt, using a procedure sensitive to between 1.0 and 10 p.p.m. Since total ash content ranged between 2.0 and 3.0 per cent for most samples, it is doubtful if the dry grass contained as much as 0.15 p.p.m. of cobalt. This figure may be compared with Askew and Dixon's (2) result of 0.1 to 0.24 p.p.m. in forages from bush sick areas. Also, Stare and Elvehjem (26) could not detect cobalt in the organs of healthy animals unless cobalt had been administered, yet Askew and Dixon (3) are able to report values for the element in animals definitely suffering from deficiency.

Becker and Gaddum (4) found 50 p.p.m. of cobalt in Reyburn's (Ruatangata) (effective) limonite spectrographically, while none was detected in Puhipuhi (ineffective) limonite, even after overexposure of the plate.

Previous publications on the use of iron compounds, in which the effective agent was cobalt impurity, are referred to in the above papers and will not be reviewed. The production of polycythemia in experimental animals by the addition of cobalt to a diet already adequate in the element (15, 17, 22, 23, 26, 30) and the reduction of mortality rate in the case of sodium cyanide poisoning (24) indicate some effects of the element. Orton (22) found that the oral and subcutaneous administration of cobalt to rats increases the proportion of reticulocytes, and also the concentration of bilirubin in the serum. The hematopoietic action is one of stimulation.

The effects of a deficiency will be reviewed with the discussion of the experiments to be reported.

EXPERIMENTAL PROCEDURE

The general experimental plan was to feed calves on a ration obtained from affected (salt sick) land and to follow changes in their condition and response to supplemental feeding, by appropriate tests.

Animals were obtained from the Florida Agricultural Experiment Station Jersey herd at birth. The herd is maintained on pasture in season, corn silage, a limited amount of alfalfa hay purchased outside the state, and mixed grain in proportion to production. Bonemeal, salt sick lick (5), and common salt are available at all times. A part of the roughage in the above ration is produced on affected land.

The basal ration was made up of Natal grass (*Tricholena rosea* Nees) hay, shelled corn, commercial spray process skimmilk powder, cod liver oil, and

whole milk. The hay was obtained from a farm where 23 out of 25 head of cattle were lost from malnutrition in a single season. The corn was produced on the Experiment Station farm on fields of the same soil types. Skimmilk was used as a source of protein to balance the ration, and whole milk was fed at the customary time. No cobalt was detected spectrographically (9) in the ash of any of these feeds, even after overexposure of the plates.

The animals were kept in individual stalls with solid partitions and bedded with excelsior waste. They were exercised in a paved concrete lot. Gainesville city water was available in an automatic water cup, except for E–85, E–86 and E–87, given distilled water in aluminum pails for a time. Feeding was twice daily, and in most cases, the offering of hay and corn was based on appetite. Skimmilk was fed after reconstitution, and the corn without grinding, as they were found to be more palatable in such forms. Very few grains of corn were found in the feces. Cod liver oil was supplied at the rate of 20 cc. daily as the hay was of poor color, and the corn was a white variety.

Common salt was available at all times. Mineral supplements were added to the milk as solutions, once daily. Ferric ammonium citrate and copper sulfate solution was tested as a supplement on account of its efficacy in field work with salt sick (5, 19). The use of cobalt was initiated upon receipt of information concerning its use in West Australia in enzootic marasmus (28).

All animals were weighed once weekly and growth curves plotted from moving averages of three weights. This procedure, rather than three-day weights every 28 or 30 days, was followed in order that such changes in body-weight as occur in conditions involving extreme anorexia might be recorded. Losses of as much as 20 per cent have been noted with animals in a single week.

Hemoglobin was determined once weekly by the Newcomer acid hematin method (21) on blood obtained by puncture of the marginal vein of the ear. Curves were plotted from moving averages of three determinations. After such curves failed to show changes concordant with change in condition of the animals, total erythrocyte counts, cell volume determinations, vital stained blood smears for reticulocytes and cell size and shape, and differential leucocyte counts were made periodically on some animals.

General condition of the calves was noted from time to time. Gross pathology was noted at the time of death or slaughter. Histological examination was made of selected organs of representative animals.

RESULTS

Growth curves for seven animals used in this study are presented in Figure 1. Additional animals have been maintained on the same ration with and without the use of iron and copper supplement with similar

results. Only three animals have received cobalt under the conditions of the experiment.

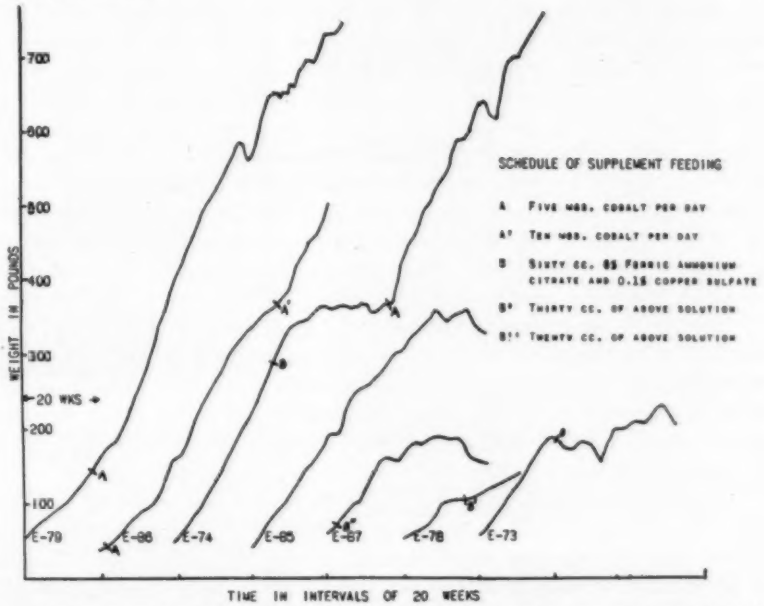

FIG. 1. Growth curves of calves showing the effect of cobalt; iron, copper and cobalt, and iron and copper supplements to a basal ration of Natal grass hay, shelled corn and skimmilk powder, the hay and corn being produced on deficient land.

Animal No. E–85 (male) on the basal ration made satisfactory growth to a weight of 360 pounds. At that point, his intake of hay and corn decreased markedly but he continued to consume skimmilk. He weighed 300 pounds at time of slaughter 15 weeks later and the carcass weighed 116 pounds.

Four calves of this group received the ferric ammonium citrate and copper sulfate solution (6% Fe $(NH_4)_3(C_6H_5O_7)_2$ and 0.1% $CuSO_4 \cdot 5\,H_2O$) at rates of 20, 30 and 60 cc. per head per day. E–73 (male) was fed the basal ration until 33 weeks of age, and then 60 cc. of the iron and copper supplement was added. His weight decreased, followed by some increase, and then another decrease and death at a final weight of 200 pounds.

A lesser amount of iron and copper supplement (30 cc. daily) was given E–78, a heifer calf dropped by a cow maintained on the basal ration, and pasture in season on marginal land. This calf continued to make slight gains but weakened and died at a weight of 145 pounds when 7½ months of age.

A still lesser amount (20 cc. daily) of the iron and copper solution was

given E–87. He reached a maximum weight of 188 pounds, which dropped to 140 pounds at the time of slaughter with a dressed weight of 58 pounds.

Animal No. E–74, an Angus-Jersey crossbred female was fed the basal ration from birth (Dec. 11, 1934) until June 15, 1935, at which time she weighed 284 pounds. Then, 60 cc. daily of the iron and copper supplement was given, and seven months later liveweight had increased only 80 pounds and dry matter intake had decreased from over 7.0 pounds to less than 3.0 pounds per day. Upon the addition of 5.0 mgs. cobalt as cobaltous sulfate ($CoSO_4 \cdot 7\,H_2O$), her feed intake quadrupled within four weeks, some response being evident within three days, and weight increase was at the rate of 50 pounds per month until she weighed over 600 pounds. Therefore, gains were less regular. She conceived to a single service and dropped a normal calf when two years old.

The first animal given cobalt in an effort to prevent the malnutrition was E–79, a full brother to E–87. The daily amount was 5.0 mgs., beginning when he was four months old. He made regular gains until a weight of 550 pounds was reached. From this point, gains were intermittent, but 740 pounds was the final weight before slaughter when 20 months of age. The dressed carcass weighed 351 pounds.

Cobalt supplementation was started with E–86 when he was four weeks old. He was a weak calf of 34 pounds birthweight. Weight increase, feed intake, and appetite were excellent until he was 10½ months old. Failure of appetite occurred at that age and the cobalt supplement was increased from 5.0 to 10.0 mgs. per day. Appetite improved immediately and gains were more rapid than previously. Whether or not the intermittent increases in weight, as in the cases of E–74 and E–79, will occur later is problematical.

No effect was noted with E–85, E–86 and E–87 from the substitution of tap water by distilled water.

Photographs of four of the above animals appear in Figure 2.

Affected cattle usually show a long rough coat of hair, scaliness of the skin, listlessness, retarded development of sexual characteristics, gauntness due to loss of appetite (much less marked when liquid skimmilk is a part of the ration), and muscular atrophy. Animals supplied iron and copper supplement exhibited these symptoms earlier than those on the basal ration, while animals receiving cobalt, or iron, copper and cobalt appeared normal in every way.

The results of hemoglobin determinations for the seven animals are plotted in Figure 3. No correlation is evident between hemoglobin level and the condition of the animal. No extreme high values indicative of polycythemia were encountered and neither were there low values as usually associated with anemia. Oftentimes there apparently was an increase in hemoglobin level when a calf lost in condition.

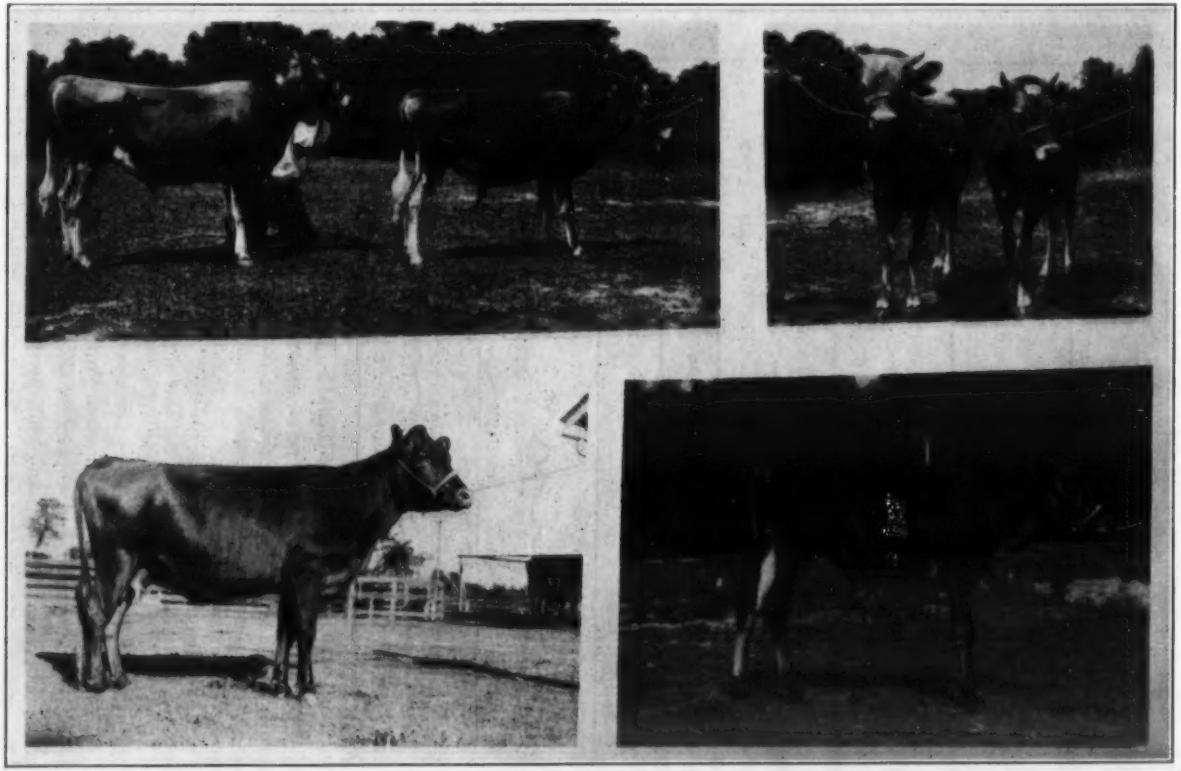

FIG. 2. Photographs showing effect of supplements to a ration of Natal grass hay, shelled corn and skimmilk powder, the hay and corn being produced on deficient (salt sick) land. Left animal in upper pictures, E–86, received cobalt while E–85, was on the basal ration. Weight difference was 200 pounds at 15 months. E–74, lower left, received iron, copper and cobalt. E–87, lower right, received iron and copper supplement.

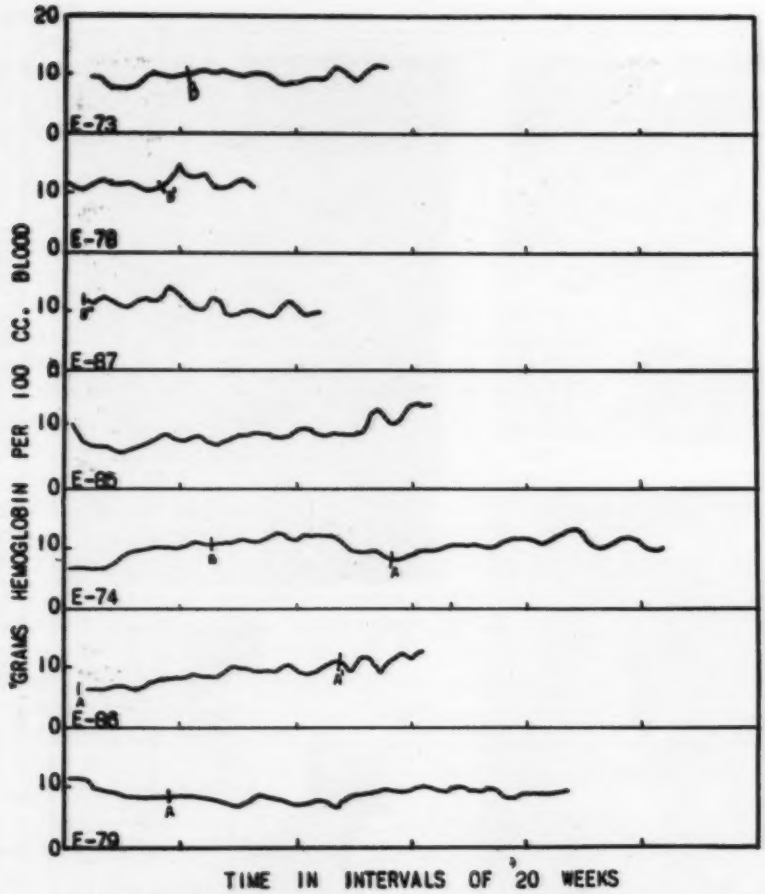

FIG. 3. Hemoglobin curves of cattle fed a ration of Natal grass hay, shelled corn and skimmilk powder, the hay and corn being produced on deficient (salt sick) land. Supplementation was as follows: A, 5.0 mgs. cobalt per day; A′, 10.0 mgs. cobalt per day; B, 60.0 cc. iron and copper solution per day; B′, 30.0 cc. iron and copper solution per day, and, B″, 20.0 cc. iron and copper solution per day. (Iron and copper solution was 6.0 per cent ferric ammonium citrate and 0.1 per cent copper sulfate.)

Total red cell counts gave results between 5.0 and 7.5 million per cmm. E–86, receiving cobalt and making normal growth, usually had a lower count than E–87 receiving iron and copper, or E–85 on the basal ration. In general, the concentration of hemoglobin per cell, and per cell volume, was lower in animals not receiving cobalt. The individual cell was larger when

cobalt was fed. The preliminary data on this phase indicate that the condition is a microcytic hypochromic anemia, even though the hemoglobin levels do not show significant differences.

Vital stained blood smears showed less than 1.0 per cent reticulocytes in all cases, regardless of supplementation. When cobalt was given, the erythrocytes appeared normal, but animals on the basal ration or receiving iron and copper supplement showed antisocytosis and poikilocytosis.

Differential leucocyte counts showed an increase in lymphocytes at the expense of the granulocytes, without significant change in the total number of leucocytes.

The most prominent internal changes are thinness and paleness of musculature, and lack of body fat. The thymus atrophies earlier than normal. The heart is less firm and is lighter in weight than normal but less so than is encountered in field cases of salt sick. The liver is somewhat smaller than average. The spleen is small with a thickened capsule and appears fibrous although the pulpy portion is usually of good color. Gelatinous exudate occurs in the thoracic and abdominal cavities, similar to its occurrence in inanition.

The myocardium shows a very striking degenerative muscle change, which is patchy in distribution. The degeneration occurs in streaks with relatively good muscle immediately contiguous. The relatively good heart muscle has a fibrous or stringy appearance. The spaces between muscle cells are increased. In some areas muscle cells fade out into degenerating connective tissue.

The most outstanding feature of the spleen was an apparent increase in trabeculi, with a decrease in spleenic pulp. The spleen of these animals had undergone a disorganization. The outer zones of the malphigian corpuscles had disappeared. A large portion of the inner zone was ill defined. Only remnants of the periarterial pulp were found. Many erythrocytes were found in the red pulp areas with an occasional basophilic cell. Miotic figures could not be found in sections of any of the spleen. The appearance of the pulpar areas was clear and open.

The most marked change in the liver was noted around the central vein. There appeared to be several stages of liver degeneration; first, deposits of fat in the liver cells; second, atrophy of the hepatic cells around the central vein; third, accumulation of pigment granules in the cells, and fourth, dilated capillaries. Another stage was the entire disappearance of hepatic cells in circumscribed areas leaving only blood vessels and connective tissue. In other areas there was a marked increase in connective tissue associated with atrophy of the liver cells.

The glomeruli of the kidney were evenly distributed and of approximately equal size. Epithelial cells have clear spaces (on basement membrane side) suggesting cellular edema. The blood vessels show edema of the adventia and to a lesser extent in the media.

Heart, liver and spleen of E–79, the only cobalt treated animal slaughtered, appeared normal both grossly and microscopically.

DISCUSSION

The results of these trials indicate very clearly the beneficial effect of a cobalt supplement to the basal ration, and the deleterious effect of ferric ammonium citrate and copper sulfate. It is felt that the iron *per se* did not have its effect directly, but more probably through depressing the utilization of the infinitesimal amount of cobalt present in the ration. Nor is it felt that the small amount of copper sulfate had any effect as one calf (18) has been fed over six times as much copper (as $CuSO_4$) on the same basal ration with no external effect beyond that of the ration. Also, another animal on a ration of alfalfa had and shelled corn has received 1.5 mgs. copper (Cu) per pound live-weight per day for 15 months without external effect. The effectiveness of the cobalt supplement when added to the iron and copper supplement in the case of E–74 is further evidence against any theory of direct toxicity of iron and copper when used with the basal ration.

The most striking effect of the use of cobalt is its effect on appetite An animal receiving cobalt would consume several times as much Natal grass hay, that was little better than sample grade in appearance, as another of the same weight not receiving cobalt. This supports the theory of the authors that the palatability of any constituent in the ration depends on the adequacy of the entire ration.

It is difficult to find any specific gross external, or internal, symptom of cobalt deficiency. Roughness of hair coat, loss of appetite, listlessness, retarded development, and emaciation are encountered in a variety of malnutritions. The blood picture is similar to that reported by Filmer (7) in which anisocytosis and poikilocytosis, and an increase in the proportion of lymphocytes were noted. No reticulocytosis has been noted in our experience, or in Filmer's. These changes are typical of anemia.

Pigment deposition (hemosiderosis) has been noted by Filmer (7), and also in the affected cattle in these experiments, in the liver and spleen. Underwood (27) noted increased amounts of iron in the liver, kidney and spleen. Fatty changes have been present in the liver in both cases, and liver fibrosis has been noted in this instance. The heart has showed myocardinal degeneration and fibrous infiltration. None of these effects were noted in E–79, the only animal slaughtered after receiving cobalt.

Analytical data as to the level of cobalt in healthy and affected animals is of questionable diagnostic value since methods must be of extreme sensitivity. Spectrographic analysis (25) has not demonstrated the occurrence of cobalt in forage known to have an adequate amount. Chemical methods require many manipulations and reagents, and are too largely dependent on the human equation. In localities where positive response to cobalt has been

secured, it is possible to eliminate other etiological factors, and expect beneficial effects from the use of the element.

The tendency in regard to mineral elements in nutrition has been to restrict consideration to those elements known to be essential. A more valid viewpoint is to make such consideration on the basis that all the elements are essential in greater, or lesser, amounts; that too great amounts may be toxic, and that the ratio of one mineral element to another, and also to the organic nutrients, is of equal importance with absolute amounts.

The specific symptoms that may be expected with a deficiency, or excess, of any element or compound are dependent on the ratio of that element or compound to all others in the ration. This fact explains the inconsistencies that occur between different animals, and animals in different localities. An exact duplication of conditions is never achieved because of the large number of variables, and this must be considered in all interpretations.

The form of the element is of great importance. It is improbable that a 1000-pound cow contains as much as 25–30 mgs. cobalt. A day's intake of cobalt in normal feeds is not over 1.0 to 2.0 mgs., yet in the case of one animal an additional response was secured by increasing the daily supplement to the basal ration from 5.0 to 10.0 mgs.

Salt sick in Florida may better be considered a generic term denoting a group of conditions with similar external symptoms. "Hill sick" is the particular term used in areas similar to those where the hay and corn used in the ration in these experiments were produced. Elements other than iron, copper and cobalt may be involved in the etiology of salt sick in various areas. With elements necessary in such small amounts, their indispensability can be determined only under conditions in which their addition to the ration gives beneficial effects.

SUMMARY

A malnutrition has been produced in calves that is prevented or cured by cobalt supplementation and is aggravated by the use of iron and copper supplement.

Appetite failure and accompanying effects on growth are most prominent. The probable non-specificity of the symptoms is considered. Indications that the condition is a microcytic hypochromic anemia are presented.

Differences between the condition and other conditions amenable to cobalt supplement are explained on the basis of other variables.

The small amount of cobalt in normal rations, and the difficulty of measuring such amounts, are stressed. Biological response is given as the sole diagnostic method at the present time.

ACKNOWLEDGMENTS

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ADDENDA

Since the preparation of this manuscript, Underwood's (Underwood, E. J., Cobalt content of iron compounds and its possible relation to treatment of anemia. Proc. Soc. Exp. Biol. and Med. 36: 296–299. 1937) analyses showing 0.4 to 41.0 p.p.m. of cobalt in various iron compounds have been received. Also, Kato has reported before the American Pediatrics Society that 55 children given ferric ammonium citrate at the University of Chicago Medical School Clinic, only 9 responded to the iron alone while 42, or 76 per cent, responded to iron and cobalt with 4 responding to neither.

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THE EFFECT OF USING TRYPTONE–GLUCOSE–SKIMMILK AGAR AND 32° C. INCUBATION ON THE BACTERIAL COLONY COUNT OF ICE CREAM*

M. W. YALE[1] AND R. C. HICKEY[2]
New York State Agricultural Experiment Station, Geneva, New York

One of the media which has been proposed to replace standard nutrient agar for the plating of milk as specified in Standard Methods of Milk Analysis (1) is a tryptone-glucose-skimmilk agar developed by Bowers and Hucker (2). Another change under consideration is the lowering of the 48-hour incubation temperature from 37° to 30° or 32° C. Breed (3) has reviewed the history of Standard Methods with special reference to the agar medium and the incubation temperature.

Mudge (4) in 1927 suggested an incubation temperature of 30° C. for 48 hours and pointed out that larger colonies and higher counts could be obtained at this temperature than at 37° C. Pederson and Yale (5) in 1934 confirmed the above and brought out two other important points in favor of the lower temperature of incubation. First, they showed that temperature variations in incubators operating at 30° to 32° C. caused less error than in incubators operating at 37° C. Second, the 32° C. count was a more constant proportion of the maximum 48-hour count than was the 37° count.

Later, Yale and Pederson (6) determined that 30° to 32° C. was also the optimum temperature range for the incubation of tryptone-glucose-skimmilk agar plates prepared from pasteurized milk. Maximum counts in the case of raw milk were usually obtained at temperatures slightly below 30° C. Study of a limited number of samples of ice cream (5) suggest that the optimum 48-hour incubation temperature for agar plates is somewhat lower than for milk and is probably between 25° and 30° C.

Extensive comparisons by other investigators, *i.e.*, Kelly (7), have established the fact that tryptone-glucose-skimmilk agar plates incubated at 32° C. more nearly indicate the true bacterial content of dairy products, especially those inferior in quality than do standard nutrient agar plates incubated at 37° C.

The bacteriological quality of ice cream is receiving increasing attention. Ice cream is a product which may contain quite a different bacterial flora from market milk, due largely to its higher sugar content, higher pasteurization temperature, variety of ingredients and low storage temperatures, both of cream used in manufacture and of the finished product.

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[1] Associate in Research.

[2] Student Assistant.

Fabricius and Hammer (8) recognized the presence of saccharophilic types and recommended addition of one per cent sucrose to standard agar, a procedure which resulted in larger colonies and increased counts. Babel (9) compared standard nutrient agar, standard nutrient agar plus one per cent sucrose and tryptone-glucose-skimmilk agar counts on 192 samples of commercial ice creams. Tryptone-glucose-skimmilk agar gave higher total counts and colonies of greater size than did the other two media while standard nutrient agar plus sucrose was superior to standard nutrient agar. These comparisons were carried out at 37° C.

Robertson (10) summarized comparative data on 412 samples of ice cream and ice cream mixes collected by 5 ice cream companies in which standard agar and tryptone-glucose-skimmilk agar plates were incubated at both 37° and 32° C. Lowering the temperature of incubation from 37° to 32° C. had a greater influence on the counts than changing the medium from standard to tryptone agar. Expressing the average 37° standard agar count (logarithmic basis) as 100 per cent, the 37° C. tryptone agar count was 116 per cent, the 32° C. standard agar count 137 per cent and the 32° C. tryptone agar count 154 per cent.

Yale and Hickey (11) studied the bacteriological quality of the ice cream supply for a small city in which no bacteriological standards for ice cream were fixed or bacteriological control established. Data are presented in this publication showing comparative standard nutrient agar plate counts at 37° C. and tryptone-glucose-skimmilk agar plate counts at 32° C. on 112 store samples of ice cream representing 12 manufacturers. Approximately one-half of the samples were taken aseptically from opened cans while the remainder were taken with the vendor's dipper. The purpose of this present paper is to discuss data collected in the same study which permit comparisons of counts to be made.

Single plates were prepared in dilutions of 1:100, 1:1,000, 1:10,000 and in some instances 1:100,000 on standard nutrient agar and on a tryptone-glucose-skimmilk agar of the following composition:

Bacto Tryptone-Glucose Agar	21.0 grams
(Agar 15 gms., tryptone 5 gms., glucose 1 gm.)	
Distilled water	1,000 ml.

pH 6.6

The above ingredients were dissolved in distilled water by boiling, 5 ml. of sterile skimmilk added, the mixture dispensed in flasks in 200 ml. quantities and sterilized at 20 pounds for 15 minutes.

RESULTS OBTAINED

Logarithms tend to minimize small differences which might otherwise be considered significant and permit the presentation of large groups of data

in a small space. Safford and Stark (12) and (13) plotted logarithms to show the relation between counts on standard agar and counts on improved agars. A similar form of graph, but one in which dots were not connected with the diagonal line, was employed in the present study.

Figure 1 shows graphically the results obtained with 112 store samples of bulk ice cream taken in Geneva during the summer of 1936.

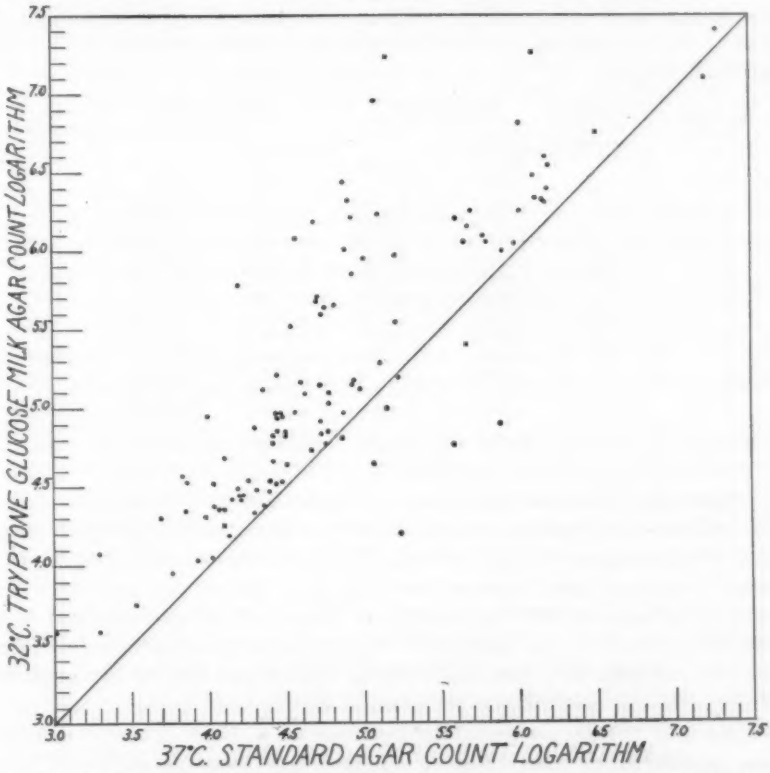

FIG. 1. Logarithms of 37° C. standard nutrient agar counts and of 32° C. tryptone glucose milk agar counts for 112 store samples of ice cream representing 12 manufacturers.

Logarithms of standard agar counts are plotted on the diagonal line. If the tryptone agar count exceeds the standard agar count, its logarithm appears above the diagonal line and vice versa. The distance vertically from each dot to the diagonal line represents a single logarithmic difference. Each dot represents a single tryptone agar count.

It is evident (Fig. 1) that the great majority of the tryptone agar counts exceeded corresponding standard agar counts and that (2) the extent of the

increase was highly variable. In 103 instances out of 112 (92.0 per cent), tryptone agar counts were higher than corresponding standard agar counts.

In comparing the quality of ice cream of individual manufacturers, the logarithms of individual counts have been averaged and converted to equivalent antilogs (Table 1).

TABLE I

Comparative quality of ice cream of 12 manufacturers based on logarithmic averages of standard agar and tryptone agar counts of 112 store samples

MANUFACTURER	NUMBER STORE SAMPLES	AGAR PLATE COUNT				PERCENTAGE DIFFERENCE
		Standard agar (48 hrs. at 37° C.)		Tryptone agar (48 hrs. at 32° C.)		
		Logarithmic Ave. of counts	Antilog	Logarithmic Ave. of counts	Antilog	
A	8	4.42609	26,700	4.55195	35,600	33
B	7	4.26786	18,500	4.66460	46,200	149
C	9	4.71674	52,100	4.82037	66,100	27
D	10	4.69552	49,600	5.08145	121,000	143
E	9	4.40887	25,600	4.96213	91,700	258
F	11	5.04345	111,500	5.44729	280,000	154
G	11	4.74271	55,300	5.22398	168,000	203
H	8	4.09388	12,400	4.35819	22,800	84
I	11	4.93291	85,700	5.34539	222,000	158
J	6	5.27843	190,000	5.13127	135,000	−29
K	12	5.10809	128,000	6.22925	1,700,000	1,221
L	10	5.81341	651,000	6.25075	1,780,000	174
Average		4.7764	59,800	5.1949	157,000	162

Theoretical standard agar count averages (antilogs) in the case of the 12 manufacturers ranged between 12,400 per gram and 651,000 per gram and tryptone agar averages between 22,800 per gram and 1,780,000 per gram. Standard agar averages were less than 100,000 per gram in 8 instances, between 100,000 and 200,000 per gram in three instances and over 200,000 per gram in one instance. Tryptone agar averages were less than 100,000 per gram in 5 instances, between 100,000 and 200,000 per gram in 3 instances and over 200,000 per gram in 4 instances. Using an arbitrary standard of 100,000 per gram, the ice cream of 4 of the 12 manufacturers was unsatisfactory when based on standard agar counts as compared to 7 manufacturers when based on tryptone agar counts (Table 1).

The theoretical percentage increase in the average tryptone agar counts over the average standard agar counts varied from minus 29 to plus 1,221 per cent, but with the exception of the above extremes, increases ranged between 27 and 258 per cent. The proportion of the total number of colonies capable of developing varied greatly with standard agar at 37° C. Obviously, this renders standard agar at 37° C. a poor instrument for measurement of quality since poor quality may masquerade as good quality ice cream. To illustrate, manufacturers C and G had average standard agar

counts (logarithmic basis) of 52,100 per gram and 55,300 per gram respectively, indicating ice cream similar in quality which would easily meet a standard of 100,000 per gram. That the ice cream of manufacturer C was really within the 100,000 standard while that of manufacturer G really failed to meet this standard is indicated by average tryptone agar counts of 66,100 per gram and 168,000 per gram respectively (Table 1).

The antilog of the average of logarithms of the counts of all samples was 59,800 in the case of standard agar, and 157,000 in the case of tryptone agar. The percentage difference of 162 per cent in favor of tryptone agar and 32° C. incubation is significant in consideration of the fact that it is based on logarithmic averages.

SUMMARY

A comparison between 37° C. standard nutrient agar counts and 32° C. tryptone-glucose-skimmilk agar counts on 112 samples of ice cream representing 12 manufacturers was made on a logarithmic basis.

Tryptone agar counts were higher than standard agar counts in 103 instances (92.0 per cent). The theoretical average percentage increase in the case of individual manufacturers varied from minus 29 to plus 1,221 per cent, but with the exception of these extremes, increases ranged between 27 and 258 per cent.

The fact that the proportion of the number of colonies developing on tryptone agar at 32° C. varied so greatly from standard nutrient agar at 37° C. indicates that the latter is a poor instrument for use in quality measurements and shows that poor quality may masquerade as good quality ice cream, where the present standard method of making agar plate counts is followed.

Wide distribution of the dots in Fig. 1 shows clearly that the number of colonies on standard agar plates incubated at 37° C. does not represent a constant proportion of the total number capable of development.

Based on the entire 112 samples, the average percentage increase in count of 162 per cent in favor of tryptone agar and 32° C. incubation is highly significant in consideration of the fact that it is based on logarithms.

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RECOMMENDED UNIFORM RULES FOR THE HERD IMPROVEMENT REGISTRY TEST

The purpose of the Breeds' Relations Committee in making the following recommendations was to simplify, without detracting from the reliability of the test, the rules for the Herd Improvement Registry Tests. State Superintendents of Official Testing are faced with the problem of explaining five dairy breed herd tests to supervisors and breeders. Building on the experience of the breed association and the state superintendents, the committee was of the opinion that a revision of the rules was possible and that a uniform set of rules for all breeds would strengthen this vitally important testing program.

A revision and supplement to the rules was recommended by the Breeds' Relations Committee and adopted by the American Dairy Science Association at Ames, Iowa, June, 1930. It was recommended by the Breeds' Relations Committee of the American Dairy Science Association at a meeting of the committee held at Dallas, Texas, October 13 and 14, 1936, and adopted by the Production Section of the American Dairy Science Association at its annual meeting held June 25, 1937, at Lincoln, Nebraska.

The following are the recommendations:

Entering herds on test.

Any owner of registered cattle of a dairy breed may make application at any time to the National Breed Association concerned to enter his herd on test, using the forms furnished by the breed association.

Identification of cows on test.

All cows on test must be identified by tattoo number or by color sketches on broken colored animals. The day, month and year of birth must be reported.

Conduct of test.

The herd test may be started at the first of any calendar month. Twelve consecutive periods of 24 hours, approximately one month apart, with or without preliminary milkings shall be required during the testing year, retests and surprise tests not to be included. Credits for milk shall begin with the fourth day after calving but no butterfat test shall be made before the seventh day. The day on which the calf is dropped is counted as the first day.

Cows to be tested.

All registered cows as long as in the herd. (See cows omitted from test.)

Cows to be omitted from test.

The following exceptions from testing may be made:

1. Cows 12 years old or over with A. R., R. O. M., R. O. P., or H. I. R. records.

2. Cows used as nurse cows throughout the lactation period having one or more A. R., R. O. M., R. O. P., or H. I. R. record meeting A. R., R. O. M., or R. O. P. requirements.
3. Cows whose registration certificates are surrendered for cancellation before the 11th month of the Herd Test year.

Requirement of milk weights.

The requirement of daily milk weights is optional.

Number of cows milked at one time.

Not more than two cows may be milked at one time, except where a combine milker is used and then not more than four units of one section may be operated by one attendant only.

Times daily cows may be milked.

Not more than three milkings per day may be permitted.

Number of cows which may be supervised per day.

Thirty cows, or if individual samples are taken, a maximum of 60 milkings may be supervised by the tester.

Samples to be tested.

Composite samples but not in duplicate. Individual samples may be permitted.

Retests.

Automatic retests are to be required when 60 days after freshening cows exceed the following daily butterfat production:

	Lbs. fat in 1 day
Mature cows	3.0
Senior 4 years old	2.9
Junior 4 years old	2.8
Senior 3 years old	2.6
Junior 3 years old	2.4
Senior 2 years old	2.2
Junior 2 years old	2.0

All retests are to be made at the owner's expense.

Surprise Tests.

One or more surprise tests with a preliminary milking shall be made by a different supervisor during the testing year. The first test is to be at the owner's expense, others at the breed association's expense.

Owner's requested retests.

The herd owner may request a retest by notifying the state superintendent of official testing within 72 hours of the close of the original test. All cows in the herd must be included in the test and at the expense of the owner.

Report blanks.

The American Dairy Science Association Herd Test Report Blanks are to be used to report the tests.

*Yearly herd average.**

In calculating yearly herd averages the production of all registered first calf heifers that have been in milk ten or more months of the herd test year and all registered cows that have ever freshened and that have been owned in the herd ten months or more of the herd test year, shall be included in the herd average.

In reporting herd averages, a supplementary list shall be furnished giving all heifers and new cows in the herd less than ten months with their production.

Dishonest or fraudulent practice.

If the state superintendent of testing is satisfied that fraudulent or dishonest practices have been used in making of herd test records of registered cows, he shall report report same to the breed association which may reject or cancel such records.

Matters not covered by rules.

Details of supervision which these rules do not specifically cover shall be administered by the state superintendent of official testing.

Revision of rules.

Any revision of the rules shall be made by a joint committee of the breed associations and the American Dairy Science Association. The chairman of the Breeds' Relations Committee shall be *ex-officio* chairman.

Committee:

S. M. SALISBURY, Ohio—*Chairman*
C. N. SHEPARDSON, Texas
C. E. WYLIE, Tennessee
R. T. HARRIS, Wisconsin
J. G. HAYS, Michigan
EARL N. SCHULTZ, Iowa—*Secretary*

* A revision of this rule was referred back to the committee by the Production Section.

AMERICAN DAIRY SCIENCE ASSOCIATION PRESENTED BORDEN AWARDS TO L. A. ROGERS AND C. F. HUFFMAN

President R. R. Graves at 11:00 A.M. on June 25, 1937, before a group of members and friends said, "We come now to a very important part of our program, that of the presentation of the Borden Awards.

I would like Dr. Ellenberger, Dr. Hunziker, and Mr. Wentworth to come to the platform.

Last fall the Borden Company announced that it would present six prizes or annual awards of $1000 in cash and a gold medal for meritorious work in science as it is related to the dairy industry. These awards were to be made in the following branches of science:

1. For work in the production field, breeding or feeding of dairy cattle, farm sanitation or quality production, etc., to be administered by the American Dairy Science Association.
2. For work in the processing field, such as improvement in equipment or methods in the handling of milk or cream and the production of milk products, to be administered by the American Dairy Science Association.
3. For work in the basic science as it is related to, or affects, the dairy industry, to be administered by the American Chemical Society.
4. For work in basic research on vitamins or other nutritional aspects of milk products, to be administered by the American Association for the Advancement of Science.
5. For work in the practical application of the findings in nutritional research, to be administered by the American Home Economics Association.
6. For work in public health as it is related to the milk industry, to be administered by the American Public Health Association.

As will be noted, the American Dairy Science Association was asked to administer the awards for work in the production field and for work in the manufacturing field. Your officers and directors thought that these awards would be a stimulus for greater effort in research for the dairy industry, that they would help to bring recognition and honor to those who were doing outstanding work in the advancement of our industry, and that our association would be glad to administer the two awards in the production and manufacturing fields.

Our Association has not heretofore administered such awards, so that we had no experience of our own to guide us in the formulation of the rules and regulations that were to govern the awards. The Borden Company left the matter of rules and regulations governing the awards entirely to the judgment of the American Dairy Science Association. We first decided that any living citizen of the United States or Canada, of either sex and of any

age, who had accomplished outstanding work for advancement of the dairy industry, would be eligible for the award. In making these rules we recognized that they would be subject to change in subsequent years as experience and practice might indicate.

The members of our board were not in accord as to the nature of the work that should be recognized in considering recipients for the awards. Some felt that a man who had bred and developed an outstanding herd of dairy cattle should be eligible for consideration; that a man who had made a conspicuous success as an administrator of a dairy enterprise, as an editor of a dairy journal, as an organizer of dairy associations or other dairy organizations, or as an inventor of dairy equipment or machinery, should be eligible for consideration. It was finally decided, however, that while accomplishments along these and other lines were meritorious and worthy of consideration, it would be difficult in many cases to measure the extent to which an individual was responsible for the success of a given enterprise; that it would be very difficult for an awards committee to weigh many of these rather intangible accomplishments against another; and that it would be best because of the shortness of time in which we had to work, this year at least, to restrict the nominations for consideration to those who had published the results of their research work during the 5-year period ending December 31, 1936. Nomination blanks together with a letter of instructions and invitation, to send in nominations of those considered worthy of the award, were mailed to each member and also printed in the Journal.

It appears to be the experience of other societies in administering such awards that it is difficult to get nominations from the membership, of all of those who are worthy of consideration. Consequently, we appointed two nominating committees, one for the production award and one for the manufacturing award. The duties of the nominations committees were to receive the nominations made by the members, from the secretary's office, and to canvass the field in order to see if any men who had accomplished outstanding research work had failed to receive a nomination, and in that case to put in a nomination for such person or persons. The production nominating committee consisted of the present and the past two chairmen of the Production Section, namely, Professor P. W. Atkeson of Kansas, Professor K. S. Morrow of New Hampshire, and Professor C. Y. Cannon of Iowa. The manufacturing nominations committee likewise consisted of the present and the past two chairmen of the Manufacturing Section, namely, Professor P. H. Tracy of Illinois, Professor L. M. Thurston of Florida, and Professor M. J. Mack of Massachusetts.

After completing their work the nominations committees were to turn over to their respective awards committees the list of nominations and data pertaining to the work of the nominees.

In selecting the members of the two awards committees, an effort was made to secure men who had had experience in evaluating research work, men who knew the problems of the industry, and men who were so well known that the results of their work on these committees could not be questioned. I think the membership of these two committees met those qualifications to an unusual degree. The membership of the manufacturing awards committee was as follows: Dr. H. A. Ruehe, Chairman of the Dairy Husbandry Department, University of Illinois, Chairman: Dr. H. L. Russell, former dean of the College of Agriculture of the University of Wisconsin and director of the Wisconsin Experiment Station and now director of the University of Wisconsin Alumni Foundation; and Dr. O. F. Hunziker, formerly professor of dairy husbandry at Purdue University and now director of research and manager of production of the Blue Valley Creamery Company. The production awards committee included the following men: Dr. H. B. Ellenberger, Head, Department of Animal and Dairy Husbandry, University of Vermont, Chairman: Dr. C. W. Larson, formerly professor of dairying, Pennsylvania State College, and later chief of the Bureau of Dairy Industry, U. S. Department of Agriculture, and now President of the Whiting Milk Company of Boston, Massachusetts, and Mr. E. G. Woodward, formerly professor of dairy husbandry of Washington State College and now a breeder of Guernsey cattle, and also the Dairy and Food Commissioner of Connecticut.

We are fortunate in having with us today Mr. W. A. Wentworth to represent the Borden Company in this ceremony. It is particularly fitting that Mr. Wentworth can present the awards for the Borden Company, for I understand that the presentation of awards by the Borden Company for outstanding work in research on problems affecting the dairy industry, is Mr. Wentworth's idea. Mr. Wentworth is in charge of Public Relations for the Borden Company. After his graduation from Iowa State College in 1910 he was affiliated with the Bacteriology Department of the Michigan Agriculture College. Shortly after this he left research work to operate a dairy herd in Iowa. From managing a dairy farm he was drawn into county agent work from where he became interested in the work of the Dairy Council. In 1923 he went to Ohio where he became Secretary of the Ohio Dairy Products Association leaving the work in 1929 to join the Borden Company.

I am going to ask Dr. Ellenberger, Chairman of the Production Awards Committee, and Dr. Hunziker, of the Manufacturing Awards Committee, to present to you the men that their respective committees have selected for these honors. Mr. Wentworth will present the prizes to the winners, and following that we have asked the recipients of the awards to tell us something of their work and to give us their intepretation of the application of their work, to the industry."

C. F. HUFFMAN

President Graves then introduced Dr. H. B. Ellenberger, Chairman of the Nominating Committee of the Production Section, who said in part, "It is a pleasure to report briefly on the work of the awards committee for the Borden prize for meritorious research in the field of dairy production. Other members of this committee are Dr. C. W. Larson, former Chief of the Bureau of Dairy Industry and E. G. Woodward, Connecticut Dairy and Food Commissioner.

This committee gave careful consideration to all who were nominated for this honor, in accordance with the rules, restrictions and methods layed down for its guidance. Its decision has the official approval of this Association.

The man who is to receive this award has through early associations, experience, education, perseverance, and accomplishments attained an enviable position in his chosen field of study and research.

Born on a farm in this wide plains country he has had intimate contact from early childhood with problems incident to the production of plants and animals. He worked his way through college from which he graduated in dairying in 1917, then entered the air service of his country until 1918.

He has had varied practical experience on dairy farms in Florida, Indiana, and Minnesota and has showed cattle at various state and national dairy shows. He has served under and worked with such teachers and investigators as J. B. Fitch, C. H. Eckles, O. E. Reed, E. L. Anthony, and G. Bohstedt.

His major contributions to research are in the field of dairy cattle nutrition dealing particularly with mineral metabolism and requirements. He and his associates have shown that dairy cattle do not suffer from a lack of calcium providing palatable roughages are fed in liberal amounts, also that the use of some mineral supplements may injure rather than benefit. He has demonstrated the fallacy of feeding high-priced complex mineral mixtures.

They have developed much information as to phosphorus requirements and under what conditions it may be deficient. He has carefully studied in much detail the usefulness and economy of home grown roughages. From these researches and others which time does not permit me to mention he has evolved new plans of feeding procedure which insure an ample supply of essential minerals, increased and better usage of home grown roughages that furnish needed nutrients at lowest cost and more efficient and economical production without unnecessary expenditure for supplements.

Presently he will tell you more about his work. I refer to Dr. Carl F. Huffman of Michigan.

Mr. Wentworth, I present Dr. C. F. Huffman for the Borden Award for meritorious research in dairy production. Dr. Huffman is a man of striking and sterling personality and character, a teacher and research leader much loved by his students and associates, a prodigious worker, unafraid to explore

new fields, not deterred by criticism, fertile minded, the center for the conception and direction of many research projects, the keen interpreter of data derived therefrom, an ardent advocate of sound basic ideas, the possessor of unusual ability to foresee and present in a clear understandable manner their application to the problems of the practical dairyman, and withal richly meriting the honor conferred with this award."

President Graves introduced Mr. O. F. Hunziker who made the following remarks:

"Mr. President, Mr. Wentworth, Officers, Directors, Members and Friends of the American Dairy Science Association: Your Committee on Borden Award for outstanding achievement in the field of scientific research devoted to the manufacture of dairy products, has diligently scanned the luminous firmament of stars and constellations of stars among the brotherhood of dairy scientists. From first to last, from horizon to horizon of the 'Milky Way,' there has stood out, and there is standing out, one great and humbly blinking astral body, the brilliancy and quality of which assign to it a magnitude, and place it in a class, all of its own.

That star among the men of our profession is no stranger to any one engaged in dairy research. His work, both past and present, is recognized as distinguished and outstanding, and his achievements of exceptional scientific merit and his contributions of practical usefulness to the industry, are acclaimed from Ocean to Ocean and in every land that fosters the husbandry of the dairy cow and her product.

This great scientist of whom I am speaking, this leader in dairy research who is the unanimous choice of our Award Committee, the man whom we are proud to recommend as the most deserving candidate for the distinguished Award so generously offered by the Borden Company, is our own Dr. L. A. Rogers, Chief of the Research Laboratories of the Bureau of Dairy Industry, United States Department of Agriculture.

Dr. Rogers graduated from the University of Maine with the Degree of Bachelor of Science. He did graduate work in bacteriology and botany at the University of Wisconsin. He was Assistant Bacteriologist at the New York (Geneva) Agricultural Experiment Station. Since 1902 Dr. Rogers has been in charge of dairy research of the Bureau of Dairy Industry, first as bacteriologist of the Dairy Division and later as Chief of the Research Laboratories of the Bureau. In 1925 the University of Maryland conferred upon him the honorary degree of Doctor of Science and in 1925 his own Alma Mater honored him with the degree of Doctor of Science.

In 1927 the Association and Co-workers of Rogers presented him with a book, prepared by them, and entitled 'Fundamentals of Dairy Science.' This treatise embraces the results of the extensive research work done by Dr. Rogers and by his Associates under his direction. This book is recognized as a masterwork among the literature of dairy science. It is dedicated to Dr. Rogers with the following inimitable inscription and tribute:

To

LORE ALFORD ROGERS

In recognition of his quarter-century service in the advancement of knowledge, embracing important contributions in pure science as well as its applications to industry; and because he embodies in the highest degree their ideal of unselfish devotion and untiring loyalty, alike to his work and to his fellow workers—this volume is dedicated with admiration and affection, by those who have been privileged to serve under his leadership.

Aside from his valuable contributions to pure science, in the fields of bacteriology, chemistry and physics, Dr. Rogers has made countless important contributions of outstanding merit and usefulness to the dairy industry. His keen insight, his sound judgment, his rare genius and his indefatigable industry have brought forth discoveries and inventions of new and improved apparatus and equipment, new and improved methods of manufacture, new dairy products and improved quality of established products. These achievements have served to augment the profitable returns from the product of the dairy cow, for the lasting benefit of the industry and the consumer alike.

His discovery that butter made from pasteurized sweet cream had better keeping quality than butter made from sour, ripened cream, has revolutionized the theory and practice of butter manufacture and has saved the industry millions of dollars through prevention of quality-damaging flavor deterioration in storage and out.

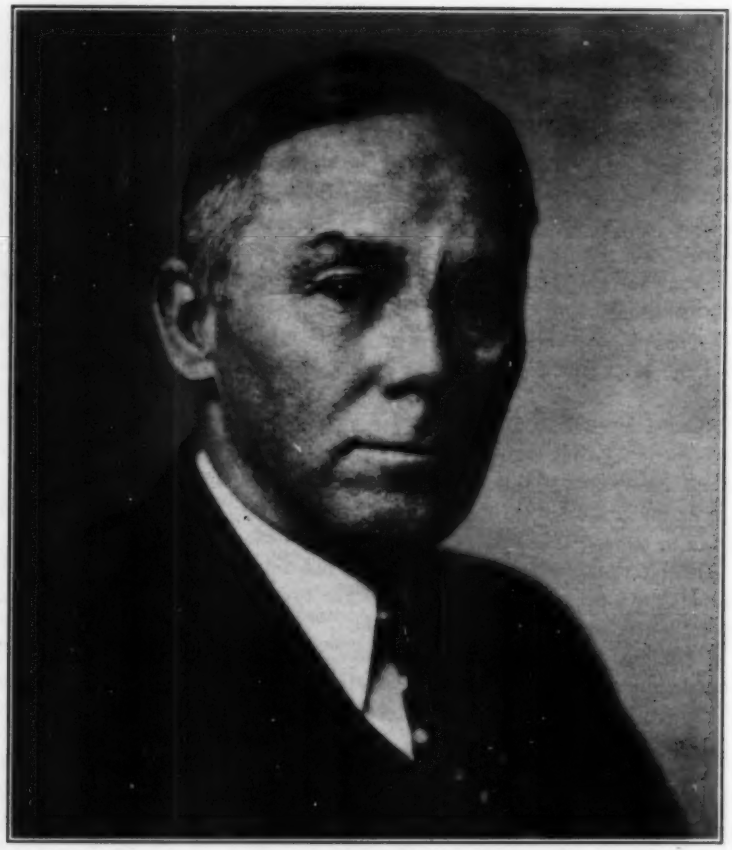
His directions for the manufacture of marketable concentrated sour milk products have provided added avenues for the profitable disposition of surplus milk and surplus milk by-products.

His extensive studies of the causes of damaging age-thickening and of the development of fungus growth in sweetened condensed milk have supplied the knowledge and the means to preserve the quality and the market value of this dairy product when held in storage.

His researches on the heat coagulation of evaporated milk have been instrumental in improving the process and in eliminating costly losses in the manufacture of this important dairy product, the annual output of which runs into billions of pounds.

His work on Roquefort cheese has demonstrated the feasibility of the commercial manufacture of domestic Roquefort cheese of good quality from cows' milk.

His profound penetration into the mysteries of the bacteriology of Swiss cheese has paved the way to the development of an improved method for the manufacture of domestic Swiss cheese of high quality and dependable digestibility.



LORE ALFORD ROGERS

His invention of the valve-vent can, and of its proper use, for packing and curing Cheddar cheese has enabled the cheese factory to provide the trade and the consumer with high quality Cheddar cheese in the consumer's package and without the development of rind that is wasteful to the consumer.

The vast investigations conducted under his directions concerning the keeping quality of powdered milk have been of great economic value to the dried milk industry.

His development of new marketable dairy products from concentrated and dried whey has enhanced the usefulness and market value of the by-products of the cheese factory.

In short, the contributions which Rogers has made to the dairy industry are legion. There is not a branch of our industry that has not felt the helping hand of his genius.

Mr. Wentworth, I have the honor to present to you Dr. L. A. Rogers, Chief of the Research Laboratories of the Bureau of Dairy Industry. By reason of his great achievements in the field of dairy science, and because of his outstanding contributions to the dairy industry, Dr. Rogers has been unanimously chosen by the American Dairy Science Association as its distinguished candidate for the honor of the Borden Award in Dairy Manufacturing."

Mr. Hunziker presented Mr. L. A. Rogers to Mr. Wentworth.

Mr. W. A. Wentworth representing the Borden Company was then introduced by President Graves and spoke as follows:

"Gentlemen of the American Dairy Science Association: At this moment in your convention proceedings we are to give recognition to two men who have been selected by their fellows as having achieved the most outstanding research work in dairying during the past five years. These men not unlike the remainder of you have been and are devoting their time, their energy, their experience, and their training—yes their culture—to progress in this great industry, dairying.

Nothing is more closely associated with the lives and fortunes of six million American farmers and one million of their like in Canada than is dairying. Progress from research brings to them wider markets, efficient hence profitable production, and economic processing and distribution.

Likewise, nothing is more closely associated with the lives and health of many millions of consumers in America and Canada than are dairy products. Progress from research has given and will give them products of this industry in which they will have confidence as to sanitation and wholesomeness. And progress in research will convince them of the nutritional qualities of milk and its products so essential to health of adults as well as children.

Research in the processing and manufacture of these products will surely reflect most advantageously to those who are engaged in milk production as well as to that great body of the public which is the market for milk and all of its products and by-products. In this field tremendous progress already has been made but the future field is limitless, unending.

Eighty years ago, Gail Borden founded what has now become The Borden Company. It was his genius for research which afforded him the product upon which he started to serve the public of New York City with a milk modified by concentration. He had seen the results from the use of milk in the condition then available and he set out to improve milk and thereby save lives and extend its availability. He wrote the first regulation for sanitary production of milk on the farm.

In recognition of the high value of research past, present and future and in perpetuating the ideals of its founder, The Borden Company sought some fitting manner in which research in dairying might be further stimulated and at the same time modestly rewarded. The American Dairy Science Association accepted the offer to administer two Borden Awards. One of these for most outstanding research work in dairy manufacturing and one for similar work in dairy production.

A committee from this Association has selected those two who in their estimation have accomplished this meritorious end.

On behalf of The Borden Company and its President, Mr. A. W. Milburn, I deem it a high privilege to present these gold medals accompanied by the payment of one thousand dollars to each of those who has been so honored by the American Dairy Science Association:

Dr. Lore A. Rogers of the Bureau of Dairying, U. S. D. A., Washington, D. C., for outstanding research work in dairy manufacturing; and

Professor Carl F. Huffman of the Michigan State College, East Lansing, Michigan, for outstanding research work in dairy production."

Doctor Huffman replied as follows:

"Words cannot express my appreciation of the honor awarded to me. It is my opinion that many of my fellow workers in the field of dairy production have made greater contributions during the last few years to the progress of dairy husbandry.

My meager contributions have been largely due to the support accorded me by my associates at Michigan State College. The whole-hearted support given to our research program by O. E. Reed, former Head of the Dairy Department, Michigan State College, and now Chief of the Bureau of Dairy Industry, and E. L. Anthony, present Head of the Dairy Department and Dean of the Agricultural Division, accounts in no small degree for the accomplishments of our dairy production research. Our progress has also been due to the splendid cooperation and assistance of Dr. C. S. Robinson and C. W. Duncan of the Section of Experimental Chemistry, Dr. E. T. Hallman

of the Section of Animal Pathology and L. A. Moore of the Dairy Section. The work of several graduate assistants has also been of valuable assistance.

Our research program at Michigan State College during the past 15 years has been characterized by long time feeding experiments. The first experiment of this kind was designed to study mineral requirements and the effect of feeding different mineral supplements, since at that time the country was being flooded with complex mineral feeds, which were supposed to cure all the troubles affecting dairy cattle. The early work at various stations indicated that milking cattle were suffering from a calcium deficiency. In our work a basal ration consisting of high grade timothy hay, corn silage and a grain mixture low in calcium gave splendid results over a period of five years. Short time metabolism trials throughout lactation indicated that although the cows were on negative calcium balances during heavy production, they stored ample calcium during medium and low production and during the dry period. At the end of three lactations the animals were slaughtered. The bones were normal.

The groups of animals fed the basal ration supplemented with bone flour or finely ground limestone rock did no better from the standpoint of reproduction, milk production and bone development than the cows on low calcium ration.

Our results and those at Vermont showed that cattle on the farms do not suffer from a calcium deficiency even when low calcium roughages are used, providing the roughages are palatable and fed in large amounts.

A group of animals received a cheap mineral supplement consisting of equal parts of finely ground limestone rock and raw rock phosphate. The health of this group of animals was adversely affected. The teeth were badly worn and the long bones showed marked changes. It was later shown that the detrimental factor in this mineral supplement was the large percentage of fluorine in raw rock phosphate. Up to the time of this work, raw rock phosphate had been recommended as a cheap source of calcium and phosphorus.

The toxic effect of fluorine in raw rock phosphate and the phosphatic lime stones accounts for our recommendation of special odorless steamed bone meal as a phosphorus supplement for dairy cattle when such a supplement is needed.

You are all familiar with our results with a highly advertised complex mineral mixture, which when fed according to recommendations of the sponsors, injured the health of the animals to which it was fed, although it was supposed to do everything except milk the cows on the farm. These results demonstrated the fallacy of feeding high powered, high priced mineral concoctions. I have informed many dairymen that it would be better for them to take their families to a "movie" rather than buy highly advertised complex mineral mixtures. Their cows would be better off and their families

would have needed recreation. The use of such mixtures is a heavy tax on the dairy farmer.

We have in progress at the present time a long time experiment designed to study the symptoms of phosphorus deficiency and phosphorus requirements, when alfalfa and the cereal grains with and without corn silage make up the ration.

Many years ago the dairymen in certain sections of Michigan who fed alfalfa and the cereal grains reported that their cattle chewed bones and wood. This condition was relieved by feeding bone meal. With the increased alfalfa acreage, this problem became a very important one.

This experiment has been in progress nine years. We have observed that cattle suffering from severe phosphorus deficiency lose their appetite for roughage and do not manifest depraved appetite until they are on the borderline of phosphorus deficiency. The results have enabled us to formulate a tentative standard for milking cows, using appetite for hay, blood inorganic phosphorus values and short time balance trials as criteria of phosphorus needs. This work is the basis of our recommendation that cows fed a home grown ration of alfalfa hay and the cereal grains with and without silage be allowed free access to a mixture of equal parts of bone meal and salt.

In order to study the calcium and phosphorus relationship more effectively, the vitamin D requirement of calves and the vitamin D value of solar radiation, sun cured hay, corn silage, irradiated milk, cod liver oil and irradiated ergosterol have been studied.

Our results have shown the effect of vitamin D deficiency on the composition of the blood. The long bones of calves do not show changes in rickets as observed in animals which are helpless at birth. After years of study, we found that the distal end of the ribs of calves afforded the best opportunity for studying rachitic changes in calf bones. The macroscopic and microscopic changes in the distal end of the ribs are similar to the changes in the long bones of rats and children.

One of our most significant observations in connection with vitamin D and phosphorus deficiency studies has been the effect on the articulating cartilage. The pitting and erosion of the surface of the articulating cartilage brought about during a deficiency in early life, persists even though the animal receives ample vitamin D and phosphorus. These eroded areas are responsible for the name of "creep" given to phosphorus deficiency among cattle in some countries. The creeping sound is due to the rubbing of bone against bone in the articulating joint. The pits and eroded areas offer a fine place for microorganisms to lodge, which may produce arthritis. We believe the results of this work are not only of value to the dairy farmers in alfalfa areas but also have a human application.

We have also studied the effect of magnesium deficiency in the ration of calves. Such a ration results in a lowered blood plasma value. Long con-

tinued feeding of such a ration ends in the animal manifesting tetany, the production of hardening of the blood vessels, kidney injury, etc. We have worked out the magnesium requirement of calves using magnesium compounds and natural feeds rich in magnesium. The magnesium requirement of the calf and child per pound of body weight appears to be about the same. The results of this study do not have a practical application to farm conditions at the moment due to the high magnesium content of common dairy feeds.

For many years we have been studying the factors carried by hay. In connection with our first long time mineral feeding experiment a group of heifers were placed on the basal ration, except wheat straw was fed in place of timothy hay. The cows receiving timothy hay gave birth to good strong calves in every case, while the animals receiving straw had dead calves or calves which were weak and blind. The blindness was associated with constriction of the optic nerve. This work is now being carried on by L. A. Moore who has correlated this type of blindness with a lack of carotene in the ration of the dam.

It appeared from these studies that the blindness and reproductive failure observed in connection with cottonseed meal injury might be due to the lack of a factor or factors carried by good hay. A long time feeding experiment covering three generations showed that so-called cottonseed injury in cattle was prevented by feeding good hay and corn silage. As much as 17 pounds of cottonseed meal was fed per cow per day in the course of this work. Also, cottonseed meal was shown to be laxative rather than constipating in its effect on the feces.

During the past several years we have been studying the value of home grown rations of alfalfa and the various cereal grains with and without corn silage. This work has taught us how to feed these feeds to greater advantage and has aided in the formulation of new rules for feeding alfalfa hay, silage and grain. This new system enables the dairymen to market to better advantage through his cows and the crops grown on the farm. The present study of the value of roughages for milk production is yielding results which promise to be our greatest contribution to dairy production."

Dr. Rogers responded with the following:

"Under the circumstances which exist here today, I think I may be pardoned if I am somewhat reminiscent. I am thus, not because I imagine that any recital of my past misdeeds will be of especial interest, but because I would like to impress on the younger men here the progress that has been made in the nearly forty years in which I have been engaged in investigations in dairy manufacturing. I want, also, to impress upon the younger workers that the earlier investigations that seem so simple and obvious in the light of our present knowledge, so easy with the equipment now available, were anything but simple and obvious the first time they were done. I am

often reminded of the late lamented Dr. Cook's statement in his account of his alleged ascent of Mt. McKinley in Alaska, to the effect that he made so much better time traveling over a route through the wilderness than a geological survey party had made the previous season. What he neglected to state was, that he was traveling on a path made by the Geological Survey party. Progress in a new field of science is always much easier and faster if someone has made a path, but many investigators, like Dr. Cook, forget their indebtedness to the men who blazed the trail.

I would like also by citing some examples from my own experience to emphasize the value, even the necessity, of fundamental research in solving the practical problems which confront us.

I imagine that it is difficult for the younger people here to realize the changes which have taken place in the brief span of 40 years. When I began my work transportation was literally in the horse and buggy stage. Electric cars were comparatively new. Boys were still riding high-wheel bicycles, horseless carriages were not taken seriously, and the airplane was only a dream of crack-brained inventors. The telephone had not yet come into general use, and the radio was not even a dream. The scientific world had just been startled by the discovery and application to medicine of the Roentgen rays.

In the dairy field pasteurization was discussed and used surreptitiously but was generally regarded with suspicion and hostility. Bacteriology was then a very young science, and the use of special cultures for buttermaking was a decided innovation, generally regarded as futile. Cream was ripened to a high acidity to develop a pronounced flavor, and protect it against deterioration.

It was into these conditions that I, an inexperienced, and according to our present standards, ill-trained young fellow only recently out of college, was projected to solve the problem of what made butter fishy. I suppose very few of you here have ever tasted really "fishy" butter, but in those days you couldn't avoid it. A large part of the butter held in storage became fishy. The butter maker at one of the large centralizer creameries which at that time made butter from unneutralized cream assured me that all of their butter put in storage would come out fishy.

This would be a comparatively simple problem in the light of our present knowledge and would be solved in the laboratory using tools and information which were unheard of at that time.

Instead of working in a laboratory, I went into the field to study the conditions in the creameries where fishy butter was made. How meager a conception I had of the nature of the problem may be gathered from the fact that much time and effort were spent in studying the flora of the pastures of the region. Two fortunate observations, made in the course of this work, led to more exact work and conclusions of some importance to the butter

industry. Storage butter which Mr. C. E. Gray and I had made at the University of Wisconsin creamery from sweet pasteurized cream was given a high score by commercial judges who knew nothing about the history of the butter, while ripened cream butters from the same lot went off flavor in proportion to the acid developed. The second observation was made at the hotel in the small Wisconsin town where I was working. After a summer of disappointment at the failure of the creamery to make any fishy butter I was elated to find on the table one night farm butter with a perfect fishy flavor. After some diplomatic negotiations through an intermediary who spoke the language of the natives I was able to examine the cream from this farm and the butter made from it. This disclosed nothing unusual, except the presence of an exceptionally active lactic culture, but with this culture I was able to make, experimentally, butter which became fishy.

I cannot say that I ever found the cause of fishy flavor. Some of the statements we made are, in the light of more recent work, obviously incorrect. But it is safe to say that the work which developed from these field observations established the fact that much of the deterioration of butter, and especially butter held in cold storage, is due, not to bacteria, but to chemical changes in which oxidation accelerated by acid and metal salts, play the important rôle. While these results were received with skepticism, in a few years, as pasteurization came into general use, the high acidity formerly developed in the cream before churning was gradually replaced by a very mild ripening or by no ripening at all. The result of this change has been an almost complete disappearance of fishiness and some of its related flavors. The greatest value of this work at the present time, and the only excuse for introducing it here, is the example which it affords of how not to do research work.

If this investigation could have been properly conducted in a laboratory by a personnel qualified to measure and evaluate delicate chemical changes and the factors which control them, conclusive results could have been obtained in half the time. But this merely proves that hindsight is better than foresight.

My official classification is Bacteriologist, and I have ventured into that field even to the extent of doing some work which could be classed as pure bacteriology, a term which I dislike very much because it carries the implication that bacteriology which has an application is impure or corrupt.

At one time we became interested in the gas-forming bacteria occurring in milk which led us at once into the confusion of the colon aerogenes group. At that time, while there had been two or three papers indicating the lines of demarcation between the families of the group, there were no certain means of distinguishing one species from another, and their sanitary significance was a matter for debate. By applying exact chemical methods we were able to distinguish two physiologically distinct species, one of intes-

tinal origin, and one widely distributed in nature and, consequently, of no sanitary significance in water, and established simple tests for differentiating one from the other.

While these results had a value in bacteriological work, the really significant outcome of this investigation was Dr. Clark's classical research on the determination of the hydrogen ion and its application in biology. Physical chemists were discussing the hydrogen ion but to bacteriologists it was news from a new battle front. It is hardly possible to overstate the importance of this work in all branches of biological research, and in the industries its applications appear in the most unexpected places. To me, its greatest use is the example which it provides of the value of abstract research in solving industrial problems.

When Dr. Clark first showed us that the growth of microorganisms was controlled by the hydrogen ion concentration to which the titratable acidity was an unsafe guide, Dr. James M. Currie was working on the acids produced by various molds isolated from Roquefort cheese, a subject which in itself did not promise any results of immediate value. Among these molds he had one which produced an unusual amount of citric acid. Dr. Currie reasoned that by controlling the hydrogen ion concentration of a culture medium at the proper point, he could maintain his molds free from bacteria and produce citric acid commercially. There was a long and rough road between the idea and its successful commercial development, but the factory that finally materialized makes citric acid in quantities measured in tons per day.

At the time this country went into the World War there was a demand for large quantities of casein of high purity for use in airplane construction, and we were asked how it could be obtained. After a night of consideration, Dr. Clark outlined a method of making casein which involved precipitation and washing of the casein at its isoelectric point. This he predicted would maintain the casein in a granular condition, which would facilitate the removal of the impurities which affected the adhesive strength of the product. These principles have proven so sound that through their application a large commercial factory now makes a casein approximating in its purity and strength the standard Hammerstein casein of the laboratory.

Another example of the unexpected application of abstract research to industry is found in an attempt we made to explain why a bacterial fermentation always ran a definite course and stopped when certain conditions were established. We found that by maintaining the pH at the optimum reaction for a particular culture a rapid and complete fermentation of the lactose whey could be induced and, further, that by supplying fresh fermentable material the fermentation could be maintained almost indefinitely at a maximum speed. As a result of this work lactic acid is now produced profitably on an extensive scale from whey. While the continuous method is not used

the capacity of the fermentation plant may be doubled at any time by introducing this procedure.

An indefinite number of illustrations could be given of the unexpected results of practical value which have come from investigations which were planned to solve some problem of a purely abstract nature. It may be possible to predict the answer to the question first asked, but no one can foresee the sidelines which may develop.

There is a border line between what we are in the habit of calling invention and investigation that is difficult to define with exactness. We usually think of invention as something that develops more or less spontaneously in the mind of a brilliant person while new ideas that come through investigation are the result of time and labor. Edison may be taken as the type of the inventor, while Langmuir, with some brilliant inventions to his credit, is clearly an investigator.

In the dairy industry a large part of the progress has been due to the inventor type. In our own work the method of canning cheese could properly be classed as invention, and like many other projects of this type, now serves as an illustration of how not to be an inventor. The large commercial laboratories are now attacking problems of this type by systematic, logical methods which rarely fail to produce results.

The first step is a clear definition of the problem. In this case it was to develop a package which would obviate the evident disadvantages of the usual methods of selling cheese. If, among the several methods available, the tin can was selected as the most likely solution, the problem of disposing of the gases formed in the normal ripening would soon be evident to anyone experienced in cheese work. While there were several possibilities, the element of invention would come into the investigation at this stage in the conception of a valve which would permit the escape of the gas without admitting air. While this seems a perfectly obvious thing to do after it is suggested the one who makes it obvious is an inventor.

In the art of invention as it is practiced in the good commercial laboratories the valves already on the market would be studied and if any seemed promising, methods and apparatus devised for testing them under controlled conditions.

The requirements which must be met are ability to exclude air under all conditions, invariable release at a predetermined low pressure, freedom from sticking, and a low cost. All of these things can be measured by physical instruments and designs and materials selected before the crucial test of packing cheese is made. How far we were from following approved methods may be inferred from the fact that we tested the valves by canning cheese, and when one was finally perfected and a patent obtained we found that at least two earlier patents had been granted on almost identical valves.

There is one point on which I think I may be pardoned for feeling some pride and satisfaction. This is the quality of the men and women who have been associated with me in various capacities in the work of the Dairy Industry laboratories. I need mention only a few of the former members of our staff: Mr. C. E. Gray; Dr. Meigs; Dr. S. Henry Ayers; Dr. Alice C. Evans of the National Institute of Health; Dr. Clark, Professor of Physiological Chemistry at Johns Hopkins University; Dr. Anne Benton, formerly Professor of Bacteriology at Vassar; Dr. Sherman of Cornell; Dr. Parfit of Purdue; Drs. Jackson and Frazier of Wisconsin; and Dr. Mudge of California.

Although we have never had more than five or six bacteriologists in our organization, four Presidents of the Society of American Bacteriologists, a society of one thousand members, have made their reputations in our laboratories. Two former members of our staff are members of the National Academy of Sciences. In securing men of this type we have been favored by fortune, but I would like to think that good judgment and discretion were factors of some importance.

It is not easy to obtain good men in the government service. The laws and the regulations governing appointments to the classified civil service are based on negative concepts. The viewpoint is not how can the best man for a particular position be obtained, but how can every citizen of the United States be given an equal opportunity to secure this position without influence or favoritism. But even in this the law is not consistent and one group of citizens is so favored that we frequently find our selection limited to men who are at the head of the list, not because they are better educated or more experienced than their competitors, but because they have acquired a disability in the military service.

Under these restrictions the wisest course is to select the most promising young men and develop them, so far as their natural capacity will permit, into investigators. Training investigators is like bringing up children and by the same token those who have had the least experience are the most positive about the methods that should be used. Real investigators, like baseball players, are born not made, but no one can tell what talent may be latent in unpromising material until it has an opportunity to develop. In a research organization everyone should be given as much independence and responsibility as he has demonstrated he is capable of assuming. This is said with a full realization that some men work best in double harness and to permit them to wander about without guidance or supervision is an unkindness.

In these days of efficiency engineers, advisory boards, and high-powered executives, it is hard to prevent a research organization from being stifled by over-organization, especially when it is a small unit in a gigantic institution like the Department of Agriculture.

Jefferson's political views may be out-moded, but his opinion that the best government is the one that governs least still applies to the organization of a research laboratory. The organization should be so flexible that it can be fitted to the men available. Nothing is so deadening to a research spirit as an attempt to force a group into a rigid form of organization for which they are not fitted by temperament or experience. On the other hand, it must be recognized that many of our present day problems can only be solved by a group working in cooperation. No doubt material economies of money, effort and time can be effected by properly organized investigation, but those who attempt to follow this path should first consider that successful cooperative research involves a carefully selected personnel, and on the part of some responsible person, infinite patience, perspicasity and eternal vigilance.

R. B. STOLTZ, *Secretary*

THE THIRTY-SECOND ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

R. B. STOLTZ
Secretary-Treasurer

The American Dairy Science Association was called to order by the President, R. R. Graves, in the College Activities Building on the campus of the University of Nebraska on Wednesday morning, June 23, at 9:30 A.M., for the thirty-second annual meeting. The program printed in the June issue of the JOURNAL OF DAIRY SCIENCE was arranged by a program committee headed by H. P. Davis. The July issue of the JOURNAL contains the abstracts of the various papers presented.

According to Prof. I. L. Hathaway, who had charge of registration, the attendance showed that thirty-nine states and the District of Columbia, as well as Canada, Australia, New Zealand, Denmark, British South Africa and China were represented; 228 of the 303 registrants were members. There were 76 ladies and 32 children, making a total attendance of 411. This meeting set a record for having the widest distribution of states and countries represented.

Chancellor E. A. Burnett gave the address of welcome. President Graves responded and gave a brief review of the changes that have taken place in the production side of the industry during the past seventy-five years in the United States, with some observations as to the possible trend of the changes and the part that our research may be called upon to play in the shaping of future changes.

Prof. W. H. Morton, of the University of Nebraska, was then introduced and gave a very interesting and instructive talk, entitled "How a Teacher Interprets Research."

Mr. H. Wenzel Eskedal, Landokonomisk Forsogslaboratorium, Copenhagen, Denmark, presented a paper on "Breeding and Feeding Dairy Cattle in Denmark."

Mr. O. F. Hunziker, chairman of the Journal Management Committee, presented his report which is reported in the minutes of the Board of Directors.

GENERAL BUSINESS SESSION

Friday, June 25, 10:00 A.M.–*12:00* NOON

College Activities Building, Univ. of Nebraska

SECRETARY-TREASURER'S REPORT

Circulation: A list of members and subscribers was published in the December Journal last year—members 853 and subscribers 888, making a total of 1741. This year we have

H. W. GREGORY, PRESIDENT

had 70 members lapse and 267 subscribers lapse, making a total decrease circulation of 337. We have taken in enough new members and new subscribers so that the total circulation on June 23, 1937, was 1692. We trust that before the year 1937 ends our circulation will be not less than 2,000.

The secretary-treasurer has been authorized to have an insert printed which may be used by educators to insert letters of inquiry referring the inquirer to the JOURNAL OF DAIRY SCIENCE.

The financial report of the secretary-treasurer and the report of the public accountant was then read.

Mr. J. H. Erb, chairman of the Auditing Committee, presented the following report:

June 18, 1937

To the Members of the
American Dairy Science Assn.

Gentlemen:

The auditing committee of the American Dairy Science Association has made an examination of the books and statements of the Secretary-Treasurer as of December 31, 1936.

It is our opinion, based upon such examination, that the books have been kept accurately and that the balance sheet and related summary of profit and loss fairly present the financial condition of the American Dairy Science Association.

Respectfully submitted,
H. E. OTTING
T. S. SUTTON
J. HOFFMAN ERB, *Chairman*

The proceedings of the Board of Directors was then presented by the Secretary.

MEETING OF THE BOARD OF DIRECTORS

June 22, 1937, 3:00 P.M.

The meeting was called to order by the President.

Present: R. R. Graves, H. W. Gregory, C. R. Gearhart, J. A. Nelson, Earl Weaver, E. G. Hood, R. B. Stoltz and H. P. Davis.

Absent: H. A. Ruehe and M. Mortensen.

An invitation was presented to the Directors inviting the Association to hold its next annual meeting in Ohio at Columbus and Wooster on June 14 to 17, 1938. Upon motion by Mr. Gearhart, seconded by Mr. Nelson, the invitation was accepted.

It was moved by Mr. Weaver, seconded by Mr. Nelson, that in the future the policy of our Association will be to accept applications for membership only from residents of North America.

O. F. Hunziker, Chairman of the Journal Management Board, submitted a report telling of the 1936 performance of the Journal and including the following recommendations:

1. That the Journal publish the abstracts of literature on dairy cattle.
2. That the January Journal not be sent out until after membership dues or subscriptions have been paid.
3. That the Association purchase all back numbers of Journals from the Williams and Wilkins Company.
4. That the stock of all Journals be insured.

Mr. Gregory moved, Mr. Nelson seconded, that the report and comments of the Journal Management Committee, as a whole, be adopted in its amended form. The above report is in the corrected form.

Upon motion duly seconded the Board of Directors then adjourned.

MEETING OF THE BOARD OF DIRECTORS

June 23, 1937, 4:00 P.M.

Dairy Building, Lincoln, Nebraska

Present: R. R. Graves, H. W. Gregory, J. A. Nelson, Earl Weaver, Martin Mortensen, E. G. Hood, R. B. Stoltz, H. P. Davis and C. R. Gearhart.

Absent: H. A. Ruehe.

Mr. Joe Knott came before the Directors at the previous Board meeting and invited the Association to hold its 1939 meeting on the campus of Washington State College and the University of Idaho, these two institutions to act as the joint hosts for the meeting. At this meeting of the Board the invitation was discussed and upon motion duly seconded was accepted.

After a discussion of the rules governing the Borden Award, it was agreed that the rules as changed in accordance with the suggestions agreed upon should be drawn up and submitted to the Directors for further suggestion and for approval.

Mr. Weaver moved and Mr. Gearhart seconded that the President appoint a committee to devise and recommend a procedure that is to be followed by various committees and sections that have passed resolutions, motions or statements on which it is desired to have the endorsement or approval of the American Dairy Science Association. President Graves appointed Mr. Weaver, Mr. Nelson and Mr. Gearhart to serve on this committee.

Mr. Weaver moved, Mr. Mortensen seconded, that the Board of Directors express our thanks to the Ohio members for their invitation to meet in Ohio in 1938.

The following resolutions submitted by the program committee were unanimously adopted by the individual members of the Board of Directors who were present:

RESOLUTIONS SUBMITTED BY THE PROGRAM COMMITTEE TO THE BOARD OF DIRECTORS

1. It is suggested that the composition of the Program Committee in the future shall be as follows: the chairman of the committee, as at present, is to be appointed by the

president of the Association at the institution which entertains the Association. The committee shall consist of three additional active members, namely, the chairmen of the Production, Manufacturing, and Extension sections. The committee shall have two additional advisory members, namely, the past two committee chairmen.

2. It is recommended that in the future no papers are to be considered by the Program Committee unless the abstracts of the papers are submitted with the title.

3. It is recommended that titles and abstracts of papers must be in the hands of the chairman of the Program Committee by April 15.

4. It is recommended that abstracts be limited to five hundred words and that charts, graphs, photographs and tables not be accepted.

5. It is recommended that members of the Association are to be limited to two papers of which they are authors or co-authors unless in the judgment of the committee additional titles and abstracts which are submitted fit into the program being planned.

6. It is recommended that abstracts of papers accepted by the Program Committee be not put on the program but read by title and the abstract published.

7. It is recommended that the Board of Directors consider recommending to the Journal Management Committee the possibility of publishing both the program and the abstracts as the June issue of the JOURNAL OF DAIRY SCIENCE.

Respectfully submitted,

H. P. DAVIS, *Chairman*
S. I. BECHDEL
L. S. PALMER

Mr. F. W. Atkeson submitted the report of the Production Section:

The Production Section met in Room 303 of the Dairy Building at the times scheduled on the program. F. W. Atkeson, Chairman of the section, presided at the sessions. All sessions were well attended and the quality of, and interest in, the papers presented continued at a very high level throughout. All but one of the papers listed were presented.

At the business meeting of the Production Section the Breeds Relation Committee brought in an interim report as well as a current report. The interim report, dealing with certain recommendations relative to general uniformity in matters of number of cows to be included and supervised on herd test, was adopted as presented. The current report covered two matters:

1. The proposal to amend the interim report to permit the supervision of a maximum of sixty milkings daily where individual samples are taken was adopted by the section.
2. The proposal to change the method of computing herd averages for the herd test was discussed and referred back to the committee for further consideration.

The committee on the students' judging contest reported one change in the rules for the conduct of the 1937 contest, regarding grading of oral reasons which will be done by one special judge for each breed.

A progress report of the Committee on Methods of Measuring Results of Pasture Investigations was made by R. B. Becker (Florida) and was adopted by the Section.

A progress report was presented by the special committee appointed to investigate cooperation with the committee of the Manufacturing Section on Standard Methods. The report was accepted and it was voted to make this a standing committee of the section.

Officers elected for the year 1938 were: W. E. Krauss, Chairman; H. W. Cave, Vice-chairman; I. R. Jones, Secretary.

This report is respectfully submitted by

F. W. ATKESON, *Chariman*
I. W. RUPEL, *Secretary*

Mr. P. H. Tracy read the report of the Manufacturing Section:

The Manufacturing Section has met in accordance with the schedule indicated in the official program. All but five of the fifty-one scheduled papers were presented. Papers m15, m16, m21, m35, m38 were not given due to the absence of the authors or their representatives. The sessions were all well attended and were operated strictly on scheduled time.

The revised score card for sanitary inspection of dairy farms and for the sanitary inspection of city milk plants was presented by the Score Card Committee and accepted by the Section. Reports were heard from the following committees:

1. Chemical Methods for the Analysis of Milk and Dairy Products.
2. Dairy Products Quality.
3. Bacteriological Methods for the Analysis of Milk and Dairy Products.
4. Judging Dairy Products.
5. Methods of Determining the Curd Tenison of Milk.
6. Feasibility of Establishing and Maintaining a Loose-Leaf Manual of Laboratory Methods.

C. J. Babcock of the Bureau of Dairy Industry was elected Chairman of the Section for the forthcoming year, and B. E. Horrall was elected Secretary.

P. H. TRACY, *Chairman*

Mr. C. L. Blackman read the report of the Extension Section:

The annual program of the Extension Section of the American Dairy Science Association was held in Room 102, Animal Husbandry Hall, Wednesday, Thursday and Friday, June 23, 24 and 25, 1937, with Professor C. L. Blackman, of Ohio State University, Chairman of the Section, presiding. A total of thirty papers were presented with an average attendance of sixty-five.

The program was arranged and carried out under the direction of a program committee. M. L. Flack, of Nebraska, was chairman assisted by E. J. Perry, of New Jersey, and Earl Shultz, of Iowa State College.

Assisting the general program committee were committees on extension exhibits, breeding, feeding, testing, calf club, quality and resolutions. The chairman of each committee presided for the presentation of papers by other members of the committee. The personnel of the committees, the subjects and schedules carried out are shown in the official program of the association.

The regular business session was held Friday morning, June 25, from 8 to 10 A.M. The following resolutions were adopted:

1. Whereas the Extension Section program committee, M. L. Flack, Nebraska, Earl N. Shultz, Iowa, and E. J. Perry, New Jersey, spent much time and energy outlining and planning this year's program and that as a result of their efforts all except one abstract was received, we therefore commend this committee and wish to thank those who appeared on the program.
2. The section wishes to thank the members of the faculty of the Dairy Department of the University of Nebraska for the facilities placed at our disposal and the many courtesies extended to us, both of which have contributed to making our meeting here successful and enjoyable, and that a copy of this resolution be given to Professor H. P. Davis, by the secretary of the section.
3. WHEREAS, there has been considerable discussion at this meeting regarding uniform rules and regulations for conducting D.H.I.A. testing, and Whereas, the summary of a questionnaire regarding rules sent to all the states indicated the almost unani-

mous feeling on the part of the men in these states who are actually engaged in the supervision of D.H.I.A.'s, that we should move cautiously,

Therefore, *Be it resolved* that only such regulations be adopted that are necessary to insure accuracy and establish confidence and yet be workable and not discourage testing.

4. WHEREAS, with the widespread recognition and general acceptance of the national identification and permanent record program, and whereas, there seems to be some apprehension of some national dairy breed associations as to the purposes of this program,

Therefore, *Be it resolved* that this section here assembled go on record as (1) heartily endorsing the program and urge the continued cooperation of the states, (2) that the program and the persons connected with it proceed in such a manner that there will be no conflict with or intentions to replace the breed herd tests, (3) that the program is not set up to establish a grade cow registry, but rather as a system of practical identification heretofore not in existence, and that a copy of this resolution be given to the breeds relation committee.

A new secretary is elected each year. The former secretary automatically becomes vice-president and the vice-president automatically becomes president. R. G. Connelly, of Virginia, was elected secretary, S. J. Brownell succeeded to the office of vice-president and Earl Shultz, of Iowa, became president for the coming year.

The section adjourned following a paper by J. Rockefeller Prentice, President of the American Dairy Cattle Club.

Mr. C. Y. Cannon, chairman; P. S. Lucas, J. C. Knott, J. W. Lynn, and E. S. Guthrie reported for the Nominating Committee as follows:

For Vice-President: C. E. Wylie—Tennessee
Earl Weaver—Michigan
Director: R. B. Becker—Florida
E. V. Ellington—Washington
Director: George C. Supplee—Dry Milk Co., Bainbridge, N. Y.
Harold Macy—Minnesota

Mr. C. J. Babcock, chairman of the Score Card Committee, consisting of L. H. Burgwald, A. D. Burke, H. F. Judkins, C. L. Roadhouse, and H. E. Ross, reported as follows:

REPORT OF COMMITTEE ON SCORE CARDS FOR THE SANITARY INSPECTION OF DAIRY FARMS AND MILK PLANTS

Because of popular demand the score cards for the sanitary inspection of dairy farms and the sanitary inspection of city milk plants have been revised, and are herewith submitted to this Association for approval.

The Committee admits that it found it impossible to incorporate in these score cards all the suggestions which they received, also that the values given to some of its items were reached by compromise. They represent, however, the earnest efforts of the committee for the past two years and the committee believes that the score cards as here presented are up-to-date, complete and practical. They were unanimously approved by the Dairy Manufacturing Section of this Association, June 24, 1937.

I, as Chairman of the Score Card Committee, therefore, respectfully request the approval of these score cards by this Association.

C. J. BABCOCK, *Chairman*

Dr. P. F. Sharp, of Cornell, chairman of the Committee on Milk Standards, reported that they would like to submit their report to the members and ask for its approval at the next annual meeting.

The Resolutions Committee gave the following report:

REPORT OF THE RESOLUTIONS COMMITTEE

Whereas the American Dairy Science Association assembled at their 32nd Annual Meeting at the University of Nebraska has enjoyed a most satisfactory program and many courtesies extended by the faculty members of the University of Nebraska and their wives. Therefore, *Be it resolved:*

That the membership of the American Dairy Science Association and their wives take this opportunity of expressing sincere appreciation to the staff of the University of Nebraska and other organizations responsible for our entertainment.

WHEREAS the Borden Company has expressed interest in dairy research to the extent of providing two $1000 awards for outstanding research in two fields of dairying and whereas the Borden Company has shown confidence in the American Dairy Science Association to the extent of asking the Association to administer these awards. Therefore, *Be it resolved:*

That we express our thanks to the Borden Company for these generous awards and for their interest in this Association. *Be it further resolved* that a copy of this resolution be sent to the Borden Company.

WHEREAS, the Bill S-2359, entitled "A Bill to Provide for the Establishment of a Bureau of Coordination of Milk and Milk Products Regulation in the Department of Agriculture, and for Other Purposes," introduced into the Congress of the United States by Senator Copeland, of New York, proposes among other things to abolish the Bureau of Dairy Industry as a major bureau in the Department of Agriculture, and to merge the activities of the said Bureau of Dairy Industry with those of the regulatory agency created by the said Bill; and

WHEREAS, the merging of regulatory and research activities into one organization results in the subordination of research work to regulatory activities; and

WHEREAS, it is the sense of this meeting that the abolition of the Bureau of Dairy Industry as an independent research bureau will be prejudicial to the best interests of the dairy industry in the United States;

Therefore, *Be it resolved* that the American Dairy Science Association voice its disapproval of the so-called Copeland Bill and urge that it be not enacted into law; and

Be it further resolved, that a copy of this Resolution be sent to the Committee on Agriculture and Forestry of the United States Congress.

K. S. MORROW
R. B. BECKER
J. H. FRANDSEN
H. C. JACKSON
J. B. FITCH, *Chairman*

Upon motion duly seconded, each report submitted was adopted and the actions of the Board of Directors for the past year were approved.

CIRCULATION OF JOURNAL OF DAIRY SCIENCE

MEMBERS AND SUBSCRIBERS IN NORTH AMERICA
AUGUST 25, 1937

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Members:

Abele, C. A., Dir. Division of Inspection, State Health Dept., Montgomery, Ala.
Bulmer, L. C., Dir. Bureau of Food & Dairy Insp., Dept. of Health, Birmingham, Ala.
Burke, A. D., Prof. of Dairying, Ala. Polytechnic Inst., Auburn, Ala.
Franklin, V. D., c/o Health Dept., Birmingham, Ala.
Shepard, Sidney, 1608 11th Place S., Birmingham, Ala.

Subscribers:

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Van Antwerp, J. C., Mobile, Ala.

Associate Subscribers:

Barber, W. H., Foremost Dairies, Inc., 2906 10th Ave. N., Birmingham, Ala.

ARIZONA

Members:

Cunningham, W. S., Univ. of Ariz., Tucson, Ariz.
Davis, R. N., College of Agric., Tucson, Ariz.
Evvard, John M., Casita Querida, 317 W. Cypress St., Phoenix, Ariz.
Woods, G. F., Fairview Dairy, Rt. 1, Box 354, Tucson, Ariz.

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Welch, D. V., Mission Dairy Inc., P. O. Box 2245, Phoenix, Ariz.

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Kelly, P. L., Dept. of Animal Industry, Univ. of Ark., Fayetteville, Ark.

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Univ. of Ark., Animal Industry Dept., Fayetteville, Ark.

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Beckley, Maurice S., 662 E. St., Davis, Calif.
Besemer, A. M., c/o Golden State Co., Ltd., 425 Battery St., San Francisco, Calif.
Bindeman, H. L., 5735 Avenal Ave., Oakland, Calif.
Boulware, J. H., Box 42, Lafayette, Calif.
Christensen, Soren, 1131 10th St., Modesto, Calif.
Cole, Wilford C., Coll. of Agric., Davis, Calif.
Dahlstrom, A. T., 264 Cherrywood Ave., San Leandro, Calif.
Day, Marcus, Golden State Co., Ltd., 1120 Towne Ave., Los Angeles, Calif.
Fenton, Jay R., R. F. D., 214 A., Walnut Creek, Calif.
Foley, Dan, 617 Main St., Vallejo, Calif.

Francis, W. A., 3331 San Carlow Way, Sacramento, Calif.
Franzen, Robert W., Room 265 West Hall, Univ. Farm, Davis, Calif.
Frevert, G. E., Del Norte Milk Products Co., Smith River, Calif.
Gray, C. E., 1404 Franklin St., Oakland, Calif.
Greene, Sam H., c/o Calif. Dairy Council, 216 Pine St., San Francisco, Calif.
Hanawalt, E. M., P. O. Box 88, Kenwood, Calif.
Henderson, Lloyd, College Park, Davis, Calif.
Hibbert, C. W., Challenge Cream & Butter Assn., 925–929 E. 2nd St., Los Angeles, Calif.
Jack, E. L., Div. of Dairy Industry, Univ. of Calif., Davis, Calif.
Jackson, George F., 1011 Maple St., Inglewood, Calif.
Jackson, H. C., P. O. Box 990, Visalia, Calif.
Kimberlin, Olin E., 201 Howard St., Petaluma, Calif.
Kohler, Roland, 2101 S. Los Angeles St., Los Angeles, Calif.
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Salisbury, S. M., Dept. of Animal Husb., Ohio State University, Columbus, Ohio.
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Strachan, Robert C., 20605 Beechwood Dr., Cleveland, Ohio.
Sutermeister, L. A., The Red Wing Corp., Dayton, Ohio.
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Svanoe, Sig, c/o United Mills Co., Dairy Div., 926–32 Wolfe Ave., Fremont, Ohio.
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Waltz, R. G., Room 20, Curren Arcade, Norristown, Pa.
Ward, Ruel E., Dept. of Dairy Husb., State College, Pa.
Welch, R. C., c/o Silver Seal Dairies, 612 S. 24th St., Philadelphia, Pa.
Welch, R. R., Div. of Agric. Extension, Penn. State College, State College, Pa.
Woolman, Henry N., Jr., Cressbrook Farm, Devon, Pa.

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Kelly, Frank W., c/o Gridley Dairy Co., 620 N. 8th St., Milwaukee, Wis.
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Miller, Paul G., Dept. of Dairy Husb., College of Agric., Univ. of Wis., Madison, Wis.
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Swanson, Arthur M., Dept. of Dairy Industry, Univ. of Wis., Madison, Wis.
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Rosell, J. M., St. Hyacinth, Province of Quebec, Canada.
Rovatt, G. E., 1116 Clifton Ave., Moose Jaw, Saskatchewan, Canada.
Skinner, H. C., Canadian Dairy & Ice Cream Journal, 122 Richmond St. West, Toronto, Ont., Canada.
Smallfield, H. A., Ont. Agr. College, Guelph, Ont., Canada.
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In table 1 on page 687 no bacteria were seen in the 60 fields examined for milks Nos. 2, 3, 4, 6, 8, 9, 10, 11, and 13. The count for each of these samples was actually zero but was to have been given as being less than 10,000. Table 1 gives the erroneous figures of 10,000 for each of these counts.

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United States Department of Agriculture

ABSTRACTS OF LITERATURE ON MILK AND MILK PRODUCTS

BACTERIOLOGY

478. Studies with A "Different Method" of Appraising Standard Plate Counts. C. SIDNEY LEETE, 24th Annual Report of Intern. Assoc. Dairy and Milk Inspectors, p. 28, Oct., 1935.

The method described in this paper is known as the "three out of four" method; it is compared to the arithmetic average and logarithmic average methods for appraising the value of a series of standard plate counts when used in determining grades of milk, degrading and in revoking milk permits.

The method consists of taking a series of four consecutive counts; if three of the four counts are within the grade, the supply is considered officially satisfactory.

The study was made on 1912 standard plate counts, and examples are cited showing the "three out of four" method to give a truer picture of the actual quality of the milk supply than either the arithmetic or logarithmic averages.

The "three out of four" method is adaptable for milk control administration. L.H.B.

479. Sources of Infection in Septic Sore Throat Epidemics. GEORGE H. RAMSEY, 24th Annual Report Intern. Assoc. Dairy and Milk Inspectors, p. 163, Oct., 1935.

Since July 1925, there were seventeen epidemics of septic sore throat reported in New York State. Each was attributed to a raw milk supply. Detailed investigation was made of thirteen of these at the time of the outbreak or shortly after. Each investigation included special epidemiological and bacteriological studies, and the careful investigation.

In seven of the thirteen epidemics, it was found that prior to the outbreaks one or more persons on the farms were involved. In four instances, there were cases of sore throat and in the other three, there were cases of hand infection in the dairy workers.

There were only two of outbreaks in which no human illness could be found on the farms inspected. In all of the eleven other cases the presence of illness on the farm at some time or other was definitely established..

In ten of the epidemics, hemolytic streps more or less similar to those from the humans involved were isolated from a single cow in each case. In the other three cases, streptococci were isolated from cows which were not similar to those from the septic sore throat patients.

In each of these instances the cows involved were animals with a history of a teat injury or mastitis.

If milk must be sold raw then every person on a dairy farm who has a sore throat, suppurating lesions, or any illness which might be due to a streptococci infection must be prohibited from handling milk, and milk from all cows with severe mastitis or teat injuries must not be used.

L.H.B.

BUTTER

Abstracts of interest are numbers 480, 481, 492, 499, and 500.

CHEMISTRY

480. Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists. 4th Edition, 1935, pp. 710. Published by the Association of Official Agricultural Chemists, Washington, D. C. Price $5.00.

The fourth Edition of Methods of Analysis follows the plan of revising the methods every five years.

New methods for the analysis of dairy products included for the first time in this edition are given for the determination of citric acid and sediment in milk; and of lactose and gums in cheese. This volume has been increased in size by 117 pages.

The A. O. A. C. methods have proved so useful to analytical chemists and have gained such widespread adoption in dairy laboratories everywhere that a review need only announce the new edition. A.C.D.

481. The Chemistry of Milk. W. L. Davies, pp. 522, 1936. Published by Chapman and Hall, Ltd., 11 Henrietta St., W.C. 2, 1936.

This book is the tenth in a series on applied chemistry published under the Editorship of E. Howard Tripp. In the preface he states that the book was written for "experts in related fields of science" and for the "well-educated layman" to "focus attention upon recent work" or to consider new aspects of old work.

Dr. Davies wrote the book to apply to pure and applied chemists and others with the thought of covering the field rather thoroughly. He states in the preface that several other books were used in "planning the various sections." A glance at the contents of the book indicates that the organization of material is somewhat similar to Fundamentals of Dairy Science.

The five sections in which the book is divided are, 1, the composition of milk, 2, the constituents of milk, 3, the physical chemistry of milk, 4, the chemistry of milk processing, and 5 the nutritive value of milk. The literature citations and discussion of the various subjects are sufficiently complete and clear to give a good up-to-date knowledge of the subject. Although the discussions are chemical in nature the language and terms are such as to be readily understandable by one in related fields of science. The

author has extensively referred to writings of English and European writers which is an added value to the book for American readers. Some idea of the extensiveness of the book may be secured from the fact that about 1400 publications are cited in the references. This book is a splendid contribution in its field. A.C.D.

CHEESE

Abstracts of interest are numbers 480, 481, and 492.

CONCENTRATED AND DRY MILKS

Abstracts of interest are numbers 478, 480, 481, 482, 491, 492, 496, 498, 499, and 500.

FOOD VALUE

482. Milk and Nutrition. Part 1. The Effect of Commercial Pasteurization on the Nutritive Value of Milk, as Determined by Laboratory Experiment. The Milk Nutrition Committee from the National Institute for Research in Dairying, Shinfield, Reading, England, and The Rowett Research Institute, Bucksburn, Aberdeen, Scotland. 1937, price 3 shillings post paid.

This publication is based upon an extensive study of the influence of commercial pasteurization of milk upon its nutritive properties. The data secured thus far deal with feeding experiments with rats and chemical analysis of the milk. The plan of the experiment was such that the raw and pasteurized milks were secured from the same original batch and the milks were processed commercially. Many variants which affected numerous previous investigations were carefully controlled.

The milk was heated in a plate heater to 142 to 150° at which temperature it was held for 28 to 44 minutes. The phosphatase test was negative. The pasteurized milk varied in bacterial count from 460 to 44,000. The milk contained 3.9 per cent fat and 12.7 per cent total solids.

Raw and Commercially Pasteurized Milks as Sources of Calcium and Phosphorus for the Growing Rat.

K. M. Henry and S. K. Kon.

The experimental rats were litter mates fed a ration containing 60 to 70 per cent of thin calcium and phosphorus requirements. About 80 per cent of these minerals were secured from milk. It was found that the rats assimilated about 80 per cent of the calcium and phosphorus intake irrespective of the kind of milk fed. From the viewpoint of these two important minerals the food value of raw and pasteurized milk were equal for rats.

An Investigation into the Effect of Pasteurization on the Availability of Calcium and Phosphorus of Cow's Milk.

D. W. AUCHINACHIE.

This investigation was a duplicate of the previous one but was carried on at another Experiment Station. The author concluded that "the retention of calcium and phosphorus of milk determined by balance experiments on growing rats have been found to be unaffected by pasteurization."

The Effect of Commercial Pasteurization on the Biological Value and Digestibility of the Proteins of Milk.

K. M. HENRY, S. K. KON, AND M. B. WATSON.

From rat feeding experiments using the method of Mitchell it was found that the protein of raw milk was 95.06 per cent digestible as compared with 95.65 per cent for pasteurized milk. Relatively low biological values of 80.73 for raw and 81.45 for pasteurized milk proteins were secured due to milk being the sole diet. It was concluded that pasteurization had no effect upon the digestibility of the milk proteins.

The Effect of Commercial Pasteurization on the Vitamin A and Carotene Content of Milk.

A. E. GILLAM, K. M. HENRY, AND S. K. KON.

In these experiments the vitamin A and carotene content of the butterfat were determined by the Lovibond Tintometer and the spectrophotometer. Data on 20 samples of butterfat showed that no vitamin A or carotene was destroyed by pasteurization.

The Effect of Commercial Pasteurization on the Vitamin B Complex of Milk

S. K. KON.

The rats in this feeding experiment were fed a vitamin B complex free diet until they began to show the effects of this deficiency in the diet. Then 8 ml. of milk were fed daily, an amount ample to promote growth at a subnormal rate. It was found that the female rats grew equally well on raw or pasteurized milks but the male rats receiving raw milk made greater gains than the male rats receiving pasteurized milk. The author concluded that pasteurization did destroy some of the vitamin B complex but the extent of the loss was not known.

The Effect of Commercial Pasteurization on the Vitamin C of Milk.

S. K. Kon and M. B. Watson.

The vitamin C content of the milk was determined by chemical titration. From data secured over a period of 4 months the vitamin C content of raw milk was 22.2 mg. per liter as against 17.5 mg. per liter for pasteurized milk. Pasteurization destroyed 20.8 per cent of the vitamin C in milk.

Comparison of the Total Nutritive Value of Raw and Commercially Pasteurized Milks.

K. M. Henry and S. K. Kon.

Milk, fortified with iron, copper, and manganese, was the sole diet of the rats in this experiment. The male rats used in the trial were liberally fed but the rats receiving raw milk were fed exactly the same volume as those given pasteurized milk. When judged by any or all standards employed, namely gain in weight, body length, composition of carcass, and appetite there was no difference between the nutritive value of raw and pasteurized milk. A.C.D.

ICE CREAM

483. An Antioxidant for Ice Cream. C. D. Dahle and D. V. Josephson, Penn. State College. Ice Cream Field *31*, 1, p. 15, May, 1937.

The authors claim that the most common flavor defect in foods containing fat is the one arising from an oxidation of fat. The defect is more likely to occur in ice cream during the winter months, primarily because the average storage period is longer in winter than summer.

As a means of preventing oxidized flavors antioxidants are often used in food products. Finely ground oat flour known as avenex No. 7 was used as the antioxidant in this study. To facilitate the development of the oxidized flavor in ice cream 2 p.p.m. of copper was added to the mix and in some instances the mixes were not homogenized. In addition the comparisons were made largely with strawberry ice cream since it is more susceptible to the development of oxidized flavors than plain. The composition of all mixes was 13 per cent fat, 10.5 per cent serum solids, 15.5 per cent sugar and 0.35 per cent gelatin. Fresh cream was used as the source of fat in most cases but in some of the comparisons frozen cream was employed. The samples were stored at -10 to $-20°$ F.

It was found that 0.5 per cent to 0.7 per cent added oat flour delayed the onset of oxidized flavor for several weeks in most cases.

When added to fresh cream before being frozen for storage a definite protection was afforded the ice cream made from the cream. The body score of the ice cream was increased by the addition of 0.5 per cent to 0.7 per

cent of the oat flour. The authors recommend 0.5 per cent oat flour rather than a greater amount because of the effect on the viscosity of the mix. W.C.C.

484. Reports Fountain Sales in Chain Drug Stores. (ANONYMOUS.) Ice Cream Trade J. *33*, 6, p. 16, June, 1937.

According to the U. S. Bureau of Foreign and Domestic Commerce, fountain sales in chain drug stores were 9.37 per cent greater in March, 1937, than they were for March, 1936. Total net sales were 8.5 per cent greater for the same period. W.H.M.

485. Essential Factors Involved in Making High Quality Ices and Sherbets. S. L. TUCKEY, Univ. of Ill., Urbana, Ill. Ice Cream Trade J. *33*, 6, p. 17, June, 1937.

The kind and amount of sugar and stabilizer to use in the manufacture of sherbets and water ices are given. Recommendations are also made regarding overrun in these products. W.H.M.

486. Bureau Classifies Plants in Production Groups. (ANONYMOUS.) Ice Cream Trade J. *33*, 6, p. 18, June, 1937.

According to the U. S. Bureau of Foreign and Domestic Commerce 1935 census of manufacturing plants, 31 per cent of the plants manufacture 81 per cent of the ice cream gallonage. Sixty-nine per cent of the plants make less than 50,000 gallons each and 19 per cent of the total gallonage. W.H.M.

487. Report of Committee on Laboratory Methods. A. H. ROBERTSON, 24th Annual Report of Intern. Assoc. Dairy and Milk Inspectors, p. 77, Oct., 1935.

This report tabulates replies from 72 laboratories to a questionnaire sent out regarding bacterial standards and methods of analysis used to determine the bacterial content of frozen desserts.

Its intent was to ascertain to what extent the present "Standard Methods" of the A. P. H. A. were being used. L.H.B.

488. When Ice Cream Means Votes. FRED E. KUNKEL. Ice Cream Trade J. *36*, 6, p. 23, June, 1937.

A Washington, D. C., ice cream plant along with other merchants has used successfully what is known as an Ada Christy campaign to stimulate sales and get new business. During a ten week period $2,000 in cash awards is made to the various women's organizations which take part in the campaign. W.H.M.

489. Sanitation in the Ice Cream Plant. M. J. PRUCHA, Univ. of Ill., Urbana, Ill. Ice Cream Trade J. *33*, 6, p. 25, June, 1937.

Ice cream should be safe, have a low bacteria count, and be free from all extraneous matter. High counts may be due to the growth of bacteria in the mix before freezing, contamination of the mix and ice cream by unsterile equipment, and by ingredients added during freezing. The following recommendations are given for treatment of utensils and equipment:

1. Exposure to 170° F. for at least 15 minutes, or 200° F. for 5 minutes in a steam cabinet; or
2. Exposure to a jet of steam for at least one minute; or
3. Exposure to a chlorine solution containing at least 50 parts of chlorine per million for one minute; or
4. Immersion in hot water at 170° F. or higher for at least two minutes.

W.H.M.

490. Who Should Own the Sales Cars? (ANONYMOUS.) Ice Cream Trade J. *33*, 6, p. 27, June, 1937.

The advantage of company-owned and salesman-owned cars are presented. In order to decide the better method for each respective company the best method to follow is to establish a definite system of accumulation cost figures and from this determine the most practical policy. Indications are that cost per mile seems to be in favor of company-owned cars.

W.H.M.

491. Air Conditioning in Ice Cream and Dairy Plants. G. O. WENDELL, York Ice Machinery Corp., Ice Cream Trade J. *33*, 6, p. 30, June, 1937.

Air conditioning is defined and the difference between summer and winter operations are given. A summer air conditioning system cleans, cools, dehumidifies and circulates the air and also brings in a certain predetermined amount of outside air for ventilation; a winter air conditioning system cleans, heats, humidifies and circulates the air and also brings in a certain predetermined amount of outside air for ventilation; and a year-'round air conditioning system cools and dehumidifies the air in summer, heats and humidifies the air in winter, cleans and circulates the air, and continuously adds to the system the desired amount of outside air brought in for ventilation.

The trend of the times is for more accurate control of the atmospheric conditions for comfort cooling as well as in the manufacturing processes in the dairy and ice cream plant. This is being accomplished by a more direct application and use of refrigeration and air conditioning. The results are more sanitary plant conditions, higher quality of products, more efficient plant operations, and finally a finer cooperation between the employees, the management, and the public.

W.H.M.

492. Milk Products. W. C. HARVEY AND H. HILL, pp. 388. Published by H. K. Lewis and Co., 136 Gower St., London, W.C. 1, England. Price 16s.

Last year these same authors published their book on Milk Production and Control. The present book on Milk Products would have a far more descriptive title if it had been enlarged to Milk Products and Their Control.

The book has eight chapters dealing with ice cream, cream, butter and margarine, cheese, condensed milk, evaporated milk, dried milk, and subsidiary milk products and uses for milk. Each chapter gives a brief history of the product, its method of manufacture, food value, and a more detailed consideration of methods of analysis, inspection, and legal control. The book, therefore, is especially useful for Public Health officials, inspectors, and students and it is written from their viewpoint.

As in the case of Milk Products the reviewer was again impressed with those parts of the book dealing with conditions peculiar to England. The authors have expressed their opinions with frankness which is to be commended, but exception should be taken to some opinions stated as facts. For example, after the authors have recommended ice cream as an excellent food they caution against "excessive consumption of ice cream" for "In the United States of America, this practice has transformed that country into a nation of dyspeptics." Perhaps the rather poor conditions in the ice cream industry in England as described by the authors has prejudiced them against all ice cream yet does not justify the assumption that the United States is a nation of dyspeptics. The book is, nevertheless, an interesting and valuable presentation of milk products and the public health.

A.C.D.

Other abstracts of interest are numbers 478, 480, 481, 482, 492, 495, 496, 498, 499, and 500.

MILK

493. The Coordination of American Milk Control Effort. LESLIE C. FRANK, 24th Annual Report of Intern. Assoc. Dairy and Milk Inspectors, p. 9, Oct., 1936.

The need for actual standardization of grade requirements for milk and also of grade labels is discussed.

An outline of the fundamental principles of the United States Public Health Service Uniform Milk Ordinance is given. L.H.B.

494. Educational Work as a Factor in Increasing the Extent of Pasteurization. IRA V. HISCOCK, 24th Annual Report of Intern. Assoc. Dairy and Milk Inspectors, p. 46, Oct., 1035.

The two essential factors to be considered in relation to the milk supply are (a) "that production of milk on the farm must be so conducted that the

possibility of infection will be reduced to a minimum, and (b) that subsequent pasteurization must be so scientifically applied that any infection which does occur, despite the farm production precautions, will be prevented from reaching the consumer."

The function of the milk inspector should be that of an educator rather than a policeman. He should be well trained in milk sanitation.

Plant employees should be trained in order to aid in the improvement of the efficiency of pasteurization from a public health viewpoint.

In addition to this the major problem relates to milk consumption. The public must have a more complete understanding or (a) "the value of an adequate supply of clean, safe milk, and (b) the necessity of proper care of the milk after delivery in the home, school or restaurant."

A number of facts concerning pasteurization which may be used in educational work are given, including the report of the committee on Foods of the American Medical Association, entitled "The Pasteurization of Milk."

L.H.B.

495. Radiation and the Microorganisms of Milk. K. G. WECKEL, 24th Annual Report of Intern. Assoc. Dairy and Milk Inspectors, p. 69, Oct., 1935.

The irradiation of good quality milk had very little effect on the bacterial count, however, when the numbers of bacteria in the milk being irradiated increase, there is a decided decrease in the count after the treatment.

In nine trials of low count milk, 0–50,000, the reduction after radiation ranged from +21.5 per cent to −22.0 per cent, average −0.96 per cent.

In thirteen trials on milk having a count over 1,000,000, the percentage reduction ranged from −0.69 per cent to −59.9 per cent, average −28.3 per cent.

It was also found that the keeping quality of irradiated milk was improved even in milk of good quality where there was no appreciable effect of radiation on the bacteria count. By introducing cultures of *Streptococcus lactis, Escherichia coli* or *Bacillus coagulans* into the milk, it was found that the radiation as applied to milk had no selective action on the various organisms normally found in milk. L.H.B.

496. The value of the Colon Test as a Means of Detecting Unsanitary Conditions on the Farm. M. W. YALE AND RICHARD EGLINTON, 24th Annual Report of Intern. Assoc. Dairy and Milk Inspectors, p. 116, Oct., 1935.

During the first two years brilliant green lactose bile (2 per cent) was used as the medium, but was found to be too inaccurate. The third year lactose desoxycholate agar was used, and found to be more accurate. 1 ml. and 0.1 ml. of milk were plated and the large deep red colonies counted after 24 hours incubation.

Counts of colon organisms were found to vary greatly from day to day, even when the total bacterial count on yeast extract dextrose agar remained approximately the same.

More high colon counts were obtained in June, July, August, and September than in the other months.

The authors concluded that the colon test has only slight value when used as a routine test on ordinary fresh raw milk. The fluctuations in the number of colon organisms in milk from individual producers from day to day is more chiefly due to the contamination from utensils and growth in the milk than to manurial contamination.

Colon infections of the udder was rarely found to be the cause.

L.H.B.

497. Second Annual Report of the Dairy Inspection Service. C. W. ENGLAND, Maryland Agr. Exp. Sta., Bul. 408, Jan., 1937.

This report reviews the work of the Dairy Inspection Service for the year 1936.

The Dairy Inspection Service of the University of Maryland is an agency for the administration of the Dairy Inspection Law of Maryland. This law is designed to insure fair dealings between producers and dealers and provides for the licensing of dairy plants in Maryland and of testers and weighers and samplers employed in such plants.

The report contains a list of licensed testers and weighers and samplers.

C.W.E.

498. Quality Control of Market Milk. N. E. LAZARUS, Olsen Publishing Company, Milwaukee, Wisconsin, pp. 190, 1935.

Persons not scientifically trained are especially in need of a book such as this which gives in non-technical language, practical information in regard to quality control of market milk. The author has had over 20 years of practical experience in the dairy field, much of which has been in the capacity of a consultant. Much of the information is not ordinarily included in texts written from the academic viewpoint.

The use of the direct microscopic method is stressed and recommended for the examination of process samples and pasteurized milk as well as for raw milk. Different types of microorganisms found in milk are illustrated by 40 photomicrographs which should help the beginner to identify sources of contamination. The author believes that the microscopic method has not been popularized and used generally in the dairy industry because the impression has been prevalent that the test required college trained persons. One of the objectives of the book is to provide the necessary information for the untrained person.

Some of the statements on milk as a source of vitamins and the destruc-

tion of vitamins by pasteurization are unsound. The phraseology and style of the book could be generally improved.

The author has freely expressed his opinion on many controversial points. The following statements which appear on page 3 afford an example. "We have been pulling the wool over our eyes by insisting that a milk with 10,000 colonies of bacteria per cc. was safer than a milk with 100,000. From a public health standpoint, there can be only one grade of milk. It is either safe or unsafe, and mere numbers of bacteria do not determine safety."

The book will need revision in the near future if it is to be kept up to date. M.W.Y.

Other abstracts of interest are numbers 478, 479, 480, 481, 482, 487, 490, 491, 492, 499, and 500.

MISCELLANEOUS

499. Concerted Action Will Help to Solve the Problems of Truck Owners. TED V. RODGERS, American Trucking Assn. Inc., Washington, D. C. Ice Cream Trade J. *33*, 6, p. 13, June, 1937.

Fees and taxes, size and weight regulations, and safety of motor vehicles are three problems confronting all truck owners. Many levies are allegedly collected for the development and maintenance of highways and roads. Unfortunately all these funds are not used for the purpose for which they are intended. Private and for-hire truck owners can cooperate and take action to curb this misuse of highway funds. At present there is a wide variation in state regulations for trucks. In some states a 10,000 pound pay load is permissible, and 40,000 pounds may be transported in other states. This will result in a difference in cost of hauling. Wheel load is more important than gross weight of the vehicle so far as effect on the road is concerned.

Traffic safety is important, both from the standpoint of preventing costly accidents and injury or death to individuals. Education of drivers in safe operating practices is the best solution to this problem. W.H.M.

500. What the Social Security Act Means to the Ice Cream Industry. (ANONYMOUS.) Ice Cream Trade J. *33*, 6, p. 32, June, 1937.

Regulations No. 91, Bureau of Internal Revenue, Washington, D. C., gives an explanation of the taxes paid under Title VIII of the Social Security Act. Upheld by the Supreme Court the act is now an established factor to be considered in the management of industry and commerce in this country. Forty-four states, the District of Columbia, Alaska, and Hawaii have enacted unemployment compensation laws as of May 25, 1937. W.H.M.

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  of ice cream, 127, 163
Youth training, 117

ERRATUM

March, 1937, page 33, abstract 82, paragraph 5, should read as follows:

3. Try to find persons suffering from a contagious disease, but do not penalize them by discharging or temporarily laying them off without due compensation.

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1937

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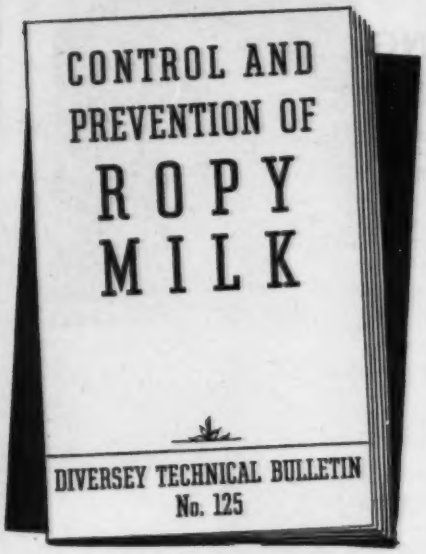

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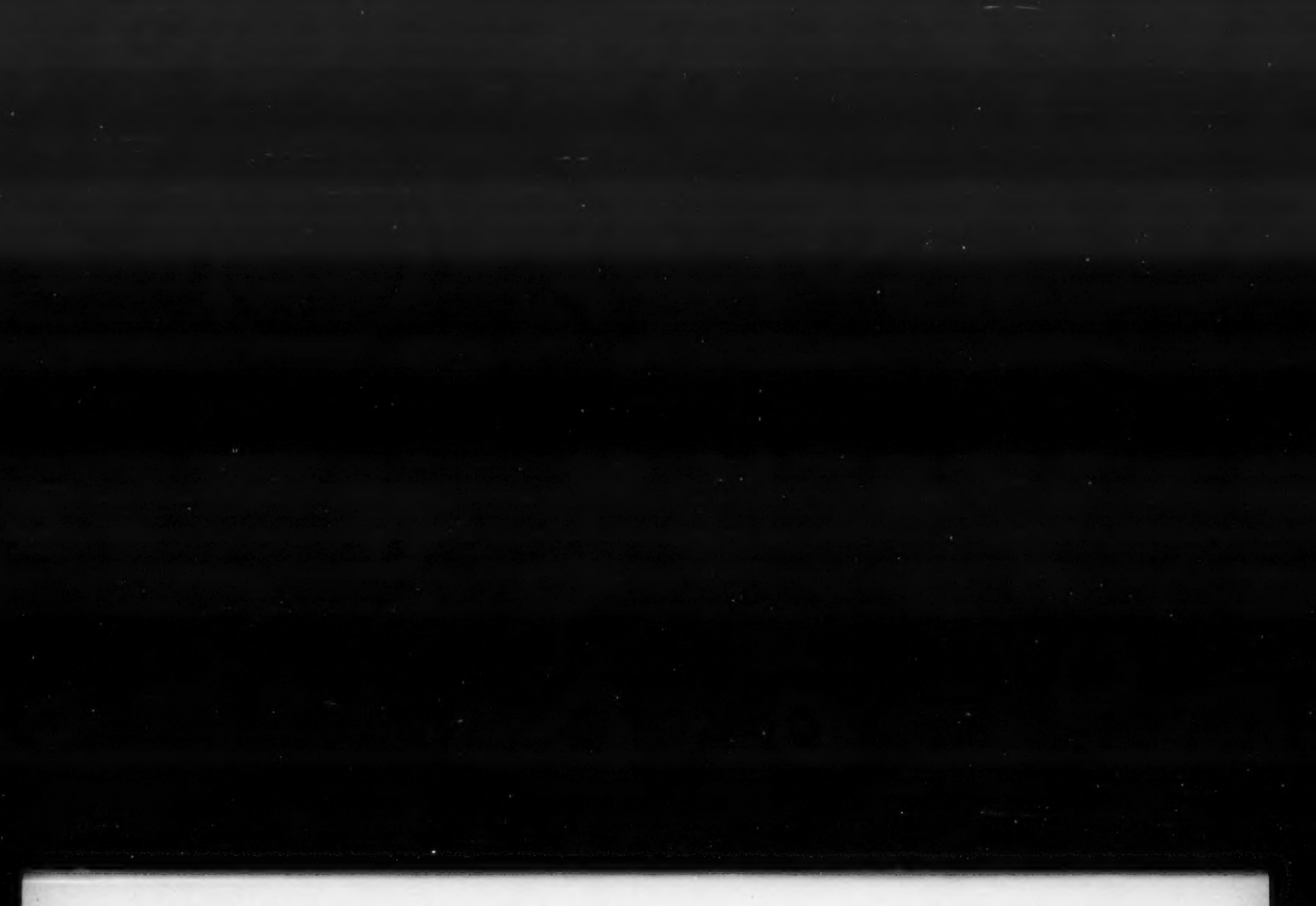

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